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Volume XIX, Part I.

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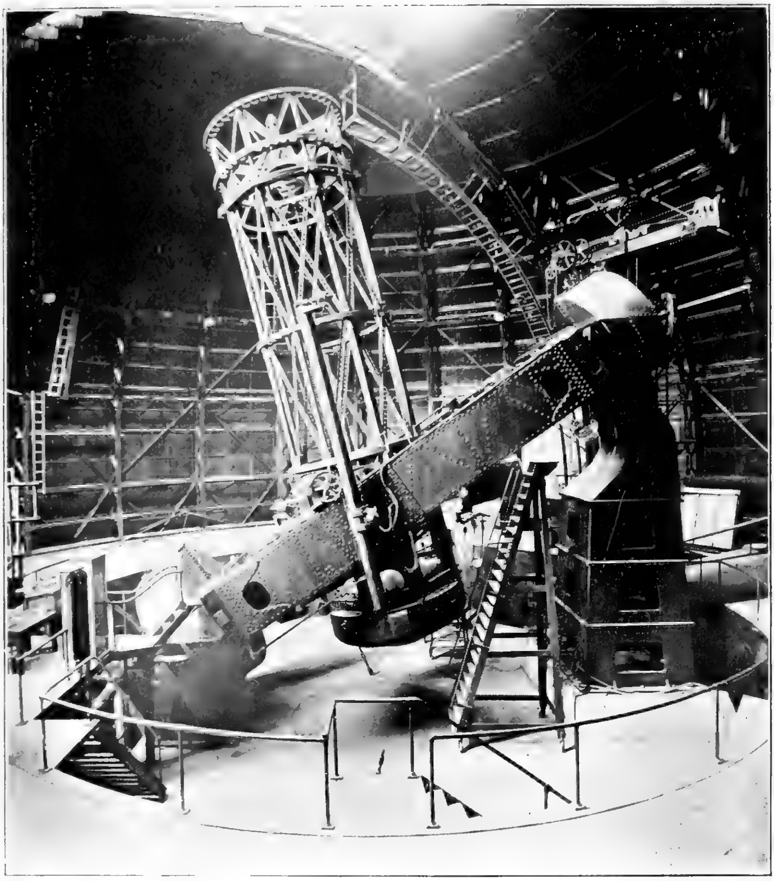


100-Inch Telescope

MOUNT WILSON OBSERVATORY

By Williams H. Knight.

On the summit of Mount Wilson, 6,000 feet above sea-level, and two-thirds of that altitude above the dust and fogs of the populous valleys below, in the clear skies and balmy atmosphere of Southern California, are planted five unique and powerful instruments.

The first instrument installed was the horizontal Snow telescope which reflects the image of the sun on every clear day, through a focal distance of 60 feet, producing an object full of surprising detail, seven inches in diameter. The next instrument projected was a tower telescope 65 feet in height, from the stationary top of which the light of the sun was reflected downward, forming a solar image in the observer's station at the surface of the ground. So successful was this experiment in solar study that another tower telescope was erected in its vicinity 180 feet in height, so constructed as to give a solar image 16 inches in diameter in a laboratory which with its adjuncts, extends to a depth of 75 feet below the surface of the ground, where the temperature is uniform. The wonderful image thus produced shows with marvelous detail, the seething, swirling motions of the various chemical elements in the sun's atmosphere. The rushing maelstrom of downward currents, and the upward thrust of red prominences seen projecting far beyond the shadow of the moon in total solar eclipses, are vividly shown in full sunlight by the spectroheliograph.

But all of these instruments were invented, designed and constructed for the purpose of studying the constitution of the sun, the nearest star in the sidereal universe. A great reflecting telescope 60 inches in diameter was also deemed essential for supplementing the original investigations being carried on by the solar telescopes. Its purpose was to make a systematic study of the myriads of other suns in the universe, to ascertain in what respects they resembled or differed from the mighty luminary at the center of our own solar system.

The work accomplished with this large telescope fully met expectations. It has thrown much light on the nature of spiral nebulae, it has demonstrated the great size and enormous distance of the globular star clusters, and contributed in scores of other ways to our knowledge of the stars. We eagerly await what is yet to be disclosed among the deep mysteries of the universe by this telescope.

Finally we come to that Brobdingnagian instrument, the great Hooker 100-inch reflector, but recently installed in the 100-foot observatory, provided with every possible facility for accurate adjustment, for delicate handling, and for convenient observing. Touch an electric button and the massive dome, whose top is 100 feet above the ground, moves at will. Another button opens a shutter 20 feet wide through which you peer at any object in the universe which may become visible in the magic glass. Another button raises or depresses the platform on which the chair of the observer is located,

The Moon, Taken by the 100-Inch Telescope.

bringing him to the eyepiece which commands any point in the celestial vault from the horizon to the zenith.

This magnificent instrument, recently installed, fully meets the most sanguine expectations of its projectors. A few weeks ago it was turned upon the moon, bringing its volcanic cones, its rugged crags, and its seamed mountain ranges within a few hundred miles of the beholder. Then Saturn with its golden rings became the cynosure of all eyes. There the giant planet stood forth, suspended in mid-heaven by an invisible force, its belted surface and its family of satellites a wonderful and tangible reality. But the climax of the occasion was capped when the monster light-gathering power of the great mirror, three times greater than that of its 60-inch neighbor, was turned upon the awe-inspiring Hercules Cluster, revealing thousands of suns massed together. A photograph made with a 100-inch telescope reveals about 30,000 stars in this cluster; the brighter ones in the center being widely separated. The invisible ones are only obtainable on long exposure.

The following account of the 100-inch telescope as published in "Popular Astronomy" and written by Dr. George E. Hale, director of the Mount Wilson Observatory, gives a concise account of this great telescope:

"After a series of tests extending over several months, the 100-inch telescope of the Mount Wilson Observatory has been found to be a complete success. The construction of this instrument, begun several years ago, was necessarily an experiment, as it was by no means certain, after the optical and mechanical difficulties had been overcome, whether the atmosphere would be sufficiently tranquil to permit clearly defined images of celestial objects to be obtained with so large an aperture. Mount Wilson, situated in the favorable climate of Southern California, where the best of results have been secured with telescopes up to 60 inches aperture, is a site as promising as any that could be found. But as observations with smaller instruments are insufficient to settle the question, the actual performance of the telescope could not be predicted with certainty.

"The tests, which permit the performance of the new instrument to be directly compared with that of the neighboring 60-inch telescope, show that the full gain in light gathering power, to be expected from the increased aperture, has actually been attained. The 100-inch telescope thus collects nearly three times as much light as the 60-inch telescope, and concentrates it in images so sharp that the gain in brightness is fully utilized. This means that the atmospheric conditions on Mount Wilson have proved to be good enough to meet the very severe demand.

"The sharpness of astronomical photographs obtained with the 100-inch telescope may be judged from some large pictures of the moon, which bring out very small details. These were taken with the combination of mirrors that give the telescope an equivalent focal length of 134 feet. Photographs of small nebulae taken at this focus also show details of structure of great interest.

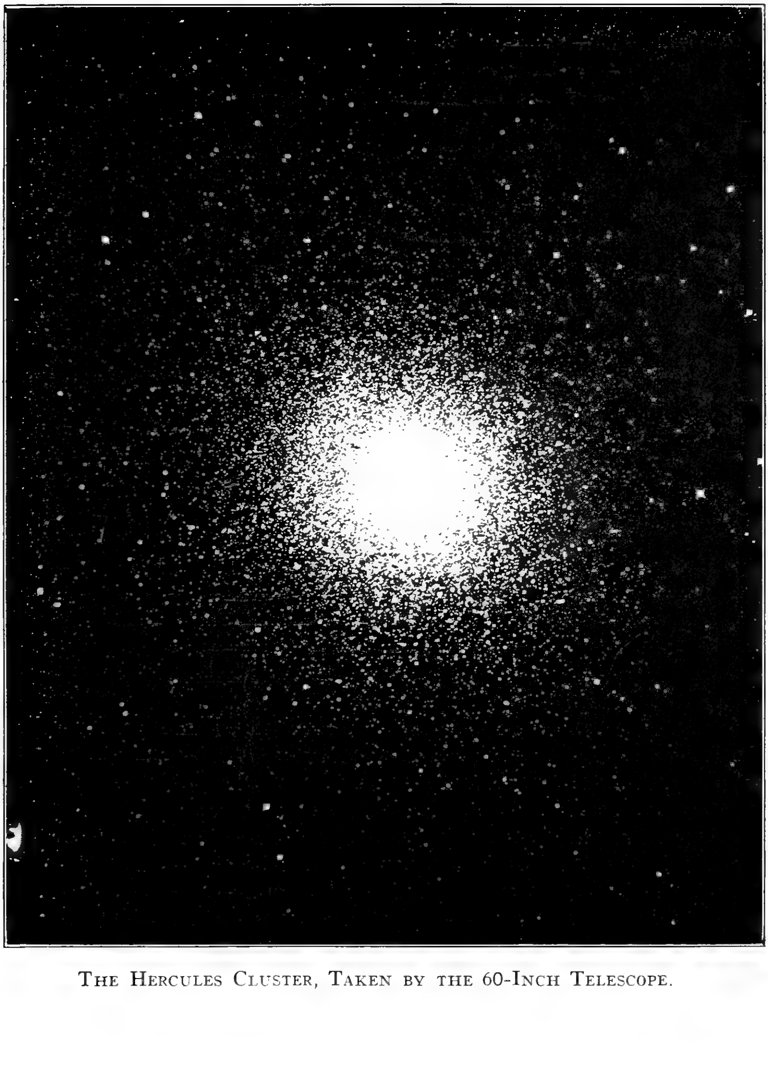
"It will naturally be the policy of the Observatory to apply the 100-inch telescope chiefly to the study of faint and difficult objects beyond the reach of our smaller instruments. Hitherto most of the observations have been made with the aid of spectographs attached at the 134 foot focus. The great light gathering power permits the spectra of extremely faint stars to be photographed with moderate exposure In this way the motions of faint stars in the heart of globular clusters and in the star clouds of the Milky Way can be measured. By applying Adams' spectroscopic method of measuring the distance of stars, it will also be possible to disinguish between stars that are faint because they are small or feebly luminous and those that are actually bright but are rendered faint by their great distance.

"A few results already obtained through the study of faint stars with the 100-inch telescope may be of interest. For the first time, except in the case of new or temporary stars, the unknown gas nebulium, the most conspicuous of the elements constituting the irregular cloud-like nebulae, has been found to be present in the atmosphere of a star (R Aquarii). This star is a faint reddish object, which varies greatly in brightness in a period of about a year.

"A faint variable star in the constellation Taurus, associated with one of the few nebulae known to vary in brightness, has been found to have an extensive atmosphere in which brilliantly luminous clouds of calcium vapor are conspicuous. Another peculiarity of this star is its extremely high temperature when near its maximum brightness.

"The faint companions of close double stars, when studied spectroscopically with the new telescope, have already yielded interesting results. Such systems are of great interest in the study of stellar evolution, but the fainter members, especially when very close to their bright companions, have previously been beyond the reach of our spectroscopes.

"These examples will suffice to illustrate the present work of the 100-inch Hooker telescope, named for the late John D. Hooker of Los Angeles, donor of its optical parts. Several new classes of observations will soon be made with the aid of special appliances now nearing completion."



The Hercules Cluster, Taken by the 60-Inch Telescope.

THE PRACTICAL APPLICATION OF CLIMATIC DATA*

By Ford A. Carpenter.

The dream of the American man of science is to practicalize his specialty so that it may be of direct value to the public.

The Los Angeles Chamber of Commerce in creating a department of meteorology and aeronautics made it possible to utilize for the good of the public the vast storehouse of meteorological and aeronautical information which has been steadily increasing for over forty years. The imperative needs of the Southern California public of intensive local application of weather knowledge were in mind when such an epochal step was taken.

The general aim of this department is to co-ordinate all air knowledge whether it be that of the Weather Bureau or of the military branches of the government. A Fellow of the Royal Meterological Society once said that he wished that the mere collection of weather data might cease for eight or ten years, or long enough to permit some direct use being made of it. This is one of the objects of this department. Another is the erection of facilities for making comparative studies, therefore it is legitimate for this department to make climatic comparisons and deductions which is a course naturally impossible for any Federal bureau.

In the field of meteorology papers have been already published on "School Attendance and Weather." Work along meteorological lines has been of special value in beginning intensive climatic surveys. The manager of the department, while official in charge of the Los Angeles Weather Bureau office finished a five year study of a 16,000 acre ranch in this vicinity. This work was accomplished in an unofficial capacity and was complimentary to the owners. This inaugurated a new era in indicating zones for different horticultural and agricultural plantings. The success attending that venture made it possible, last November, to begin a similar climatic investigation of 47,000 acres. The methods are as follows:

Automatic registration of temperature, relative humidity, rainfall, wind and sunshine is secured throughout this tract by the establishment of a number of stations scattered over the district. The results are tabulated, profiles are made by months over a period of two or more years. The accumulated data permit climatic areas to be plotted so that it will be feasible to accurately indicate zones where plantings of avocados, lemons, oranges, or other fruits may be successfully grown as well as early vegetables, beans, grains, etc. It will be readily seen that such a method will add materially to the security of investments in land holdings.

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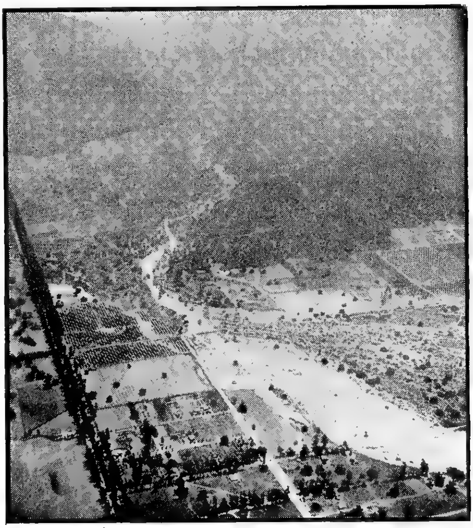
*On Sept. 16, 1919, the Los Angeles Chamber of Commerce created a Department of Meteorology and Aeronautics and placed Dr. Carpenter in charge. In addition to managing this department Dr. Carpenter is a member of the faculty of the southern branch of the University of California as lecturer in meteorology and is also a practising consulting meteorologist. In the latter capacity he is a pioneer in the commercial field.

As the meteorological department served as a clearing house for weather data, so the aeronautical department has proven a distributing center for information affecting aerial navigation in southern California. Among the more spectacular accomplishments of this department may be mentioned the photographing from the air of various varieties of cloud formations. The accompanying illustrations are from photographs made by the writer while acting as observer in a JN-4 (H-S) airplane in one of his trips from Los Angeles to San Diego and as meteorological officer on one of his free flights in spherical balloons.

As a result of the writer's balloon flights during the Spring and Summer of 1919, it was possible for him to inaugurate daily publication in the Los Angeles weather map of the Weather Bureau and in the local newspapers, tables showing the varying wind direction and velocity at different levels in the air. The United States Army Balloon School at Ross Field, Arcadia, generously cooperated in this work by telephoning "wind-aloft" data every morning. These data were used to construct flying charts in that reliable advice could be given aviators and balloonists so that they might take advantage of favoring winds in their air trips.

Meteorology is the oldest yet the newest science and its practical application to everyday phases of life, through the medium of one of the largest chambers of commerce in the world, will give it a notable impetus towards practicalizing that science.



Balloon View of the Debris Cone of the Santa Anita Canyon.

CLOUD PHOTOGRAPHS MADE FROM ALOFT

By Dr. Ford A. Carpenter.

The smaller photographs were made from an airplane over San Diego bay and the larger negative from a free balloon over San Fernando Valley.

These photographs were taken at a comparatively low elevation, the altitude of the aircraft did not exceed 2,000 feet in any of the three photographs.

Cirro-Stratus Clouds Seen Through a Layer of Cirro-Cumulus.

Cumulus Clouds with Cirrus in the Distance.

Cirro-Stratus at Sunrise from San Fernando Valley.

Linanthus Saxiphilus n. sp. Austruther Davidson, M.D.

Pale erect perennial 2-3 dm. high, branching above, stems straight, ascending, foliage and stems pubescent; leaves 4-parted, segments linear, ascending, acute; inflorescence in terminal heads of 3 or 4 flowers in each; pedicels 2-8 mm. long; calyx 10 mm. long, cleft to the middle its segments attenuate to an acute tip; corolla yellow, glabrous, its tube 1 mm. broad, exserted 3 mm. beyond the calyx throat funnelform 3 mm. long, limb ample its lobes 4 mm. wide; stamens inserted in the middle of the throat.

Rocky slope above Seven Oaks, San Bernardino Mts., July. Type 2242, in author's herbarium.

Draba saxosa n. sp. Anstruther Davidson, M.D.

Many branched perennial 12 cm. high, leaves crowded at the base, leaves oblanceolate, entire, stellately pubescent, narrowing to a petiole-like base, 20 mm. long, 4 mm. wide; stems loosely pubescent and without leaves; petals yellow, lanceolate, rounded at the apex, slightly exceeding the sepals; stamens exserted; pedicels curved or recurved one half the length of the pod; pods twisted, 10 mm. long, 2.5 mm. wide, awn 2 mm. long, pods broadest near the base.

California: Summit of St. San Jacinto; July 11, 1896. Type in author's herbarium.

This plant has passed as *D. corrugata* Wats. and has been so identified by Dr. Hall in his "Botanical Survey of San Jacinto Mountains," but it differs from *D. corrugata* the type specimens of which came from Mt. Greyback. In the latter the flowering stems are very much branched and leafy. In *D. saxosa* the stems are simple and quite devoid of leaves, the pods are more twisted and the pedicels curve so as to form a unilateral appearing spike. The pedicels in *D. corrugata* are straight and upright and the whole plant is more densely pubescent.

Hutchinsia Californica n. sp.

Slender many branched annual 15 cm. high; basal leaves orbicular or oblanceolate, short petioled; cauline leaves oblanceolate, entire or with 1 or 2 acute lobes; pods elliptic, 3-4 mm. long; whole plant glabrous.

California: Del Sur, Mohave Desert, May 12, 1893. Not uncommon in subalkaline spots in the Mohave Desert and north to Inyo County.

This is the desert representative of *H. procumbens* (L.) Desv. and differs from the maritime species in being wholly glabrous with mostly entire leaves and a slightly longer and more elliptical pod.

The Nodose Hairs on Lupines.

In a note appended to the description of *L. subhirsutus* in the last Bulletin attention was drawn to the nodose hairs on one species. These nodose hairs are limited to a few species and have in consequence a distinct diagnostic value.

Examination of the material in my herbarium shows that while a few of the following species show slightly nodose hairs on the calyx the only species showing this nodose character on the foliage are:— *L. sparsiflorus; L. concinnus; L. alpinus*. In the latter the nodes are more minute. The following show no nodose hairs on stem or foliage: *L. affinis; truncatus; hirsutissmus; Chamissonis; formosus; Bridgesii; densiflorus; odoratus; superba; Inyoensis; micanthus; Stiveri; Grayii; Breweri.*

L confertus and *L. elatius* show some minute nodes. The latter is probably the same species as *L. Inyoensis* Heller, the leaves are more silky but in other respects they are alike.

Specimens of *L. Inyoensis* gathered at Bishop Creek, alt. 9000 ft., are somewhat silky but this becomes less and less apparent as the alti-

tude increases so that at 11,000 ft. they are grayish from the lengthening of the hairs.

This has passed locally as *L. Nuttallii* Greene but differs from that species in its habit of growth, the fewer flowers in the heads, the petioled flowers, exserted corolla, and the firmer ascending, acute, leaf segments. *L. Nuttallii* branches from the base with stronger curved branches, the terminal heads are many flowered, the leaves are lax, blunt at apex and usually recurved. Miss Milligan in "Rev. Cal. Polemoniaceae," Vol. 2, p. 55, lists *L. Nuttallii* from El Toro and San Bernardino Mts. The latter is probably the one here described as *L. saxiphilus*. In our herbaria here we have no specimen of *L. Nuttallii* from anywhere south of Inyo County.

GEOLOGICAL STRUCTURES FAVORABLE TO THE ACCUMULATION OF PETROLEUM

By W. L. Watts

Geologist, Mining Engineer, Chemist and Assayer

I have been asked to say something on oil deposits that will make their nature and manner of occurrence plain to readers who have not studied petroleum geology. Therefore, I have drawn a few diagrams of simple structures which will elucidate the subject. It must be borne in mind, however, that in nature, modifications of the type forms are more frequently met with than are the simple structures.

Petroleum is a mineral very widely distributed in the crust of the earth but it requires special conditions to accumulate in valuable quantities. These conditions are: The existence of sufficiently porous rock to act as storage reservoirs and enclosing strata sufficiently impervious to prevent the escape of water, gas and oil; also a geological structure favorable to the arrangement of water, gas and oil according to their relative specific gravity.

Figures 1, 2, 3, 4, 5, 6 and 7 show geological structures favorable to the process of segregation and arrangement mentioned.

ANTICLINAL STRUCTURE

Figure 1 represents an anticlinal fold somewhat cut down by erosions; strata AA and BB are formed of porous sand containing water, gas and oil enclosed by impervious strata of shale and limestone; in stratum BB, the gas, having the least specific gravity, has forced its way through the strata containing the water and oil, and accumulated in the crown of the fold, and as the specific gravity of oil is less than that of water and greater than that of gas the oil has accumulated between the water and the gas. In strata AA and A′A′, water has driven the oil into the truncated ends of the strata. If the oil has an asphaltic base there would probably be a bed of asphaltum, a tar spring or an exposure of bituminous rock, where strata AA and A′A′ crop out at the surfice.

An oil with an asphaltic base is an oil which, after its lighter constituents are driven off by heat, leaves a residue of asphaltum. If the oil had a paraffin base the outcrop of strata AA, A′A′, would probably show a seepage of oil, or an exposure of dry oil sand. An oil with a paraffin base is one which after distillation leaves a residue of paraffin. In some instances the water may have driven all or nearly all the oil out of strata situated like AA, A′A′, but in Fig. 1 we will suppose that this is not the case.

It is evident that the wells shown in Fig. 1 must differ greatly as to results. Wells tapping the broken strata AA, A′A′, are not likely to be as productive as those tapping the unbroken strata BB; well C is drilled through into the water, well E will start off as a very good well having a long back of oil sand to draw from but its life will be short for as the oil is extracted the water will rise and capture the well; well X will have struck oil in stratum AA and water in stratum

BB, which later would have to be cased off; well Y will have missed stratum AA but will have a good production from stratum BB; well Z will have struck gas, perhaps yielding a spray of oil and as the gas becomes exhausted the oil will rise in the stratum and the gas well will become an oil well. Wells D and A will experience fortunes similar to those of wells E and C on the opposite side of the fold.

SYNCLINAL STRUCTURE

When the formation contains no water the oil will sink down the sloping sides of adjacent anticlines and collect in the syncline or basin-like depression between them; this condition is depicted in Fig. 2, in this instance the outcrop of the oil bearing stratum at CC, would probably show a dry oil sand. It is to be observed that in Fig. 2 the formation is broken and faulted near the axis of the fold; this structure would very likely occasion oil springs at points marked DD. Synclinal deposits of petroleum are of rare occurrence for the oil measures generally contain water.

DOME STRUCTURE—CLOSELY RELATED TO ANTICLINE.

Closely allied to the anticline is the dome structure. An anticline is a fold in the rocks along a line from which the strata dip in opposite directions; when this line of folding is so short that its length only equals, or but little exceeds the breadth of the fold it is spoken of as a dome. Figs. 3 and 4 are contour sketches showing the anticline and the dome structures. The dip of the strata is indicated by the direction of the arrows. It will be noted that in Fig. 3, the center line or axis AA is much longer than the breadth of the fold; in Fig. 4, axis AA but little exceeds the breadth of the structure. In the dome structure the strata dip away quite or almost from a common center. Many folds may be correctly described as elongated domes. Dome like structures are often formed by folds crossing one another.

TERRACE STRUCTURE.

Next of kin to the anticline and dome is the terrace formation, Fig. 5. This is a fold in which the strata are all inclined in one direction. It is occasioned by a sudden increase in the angle of the dip. As shown in Fig. 5, a deposit of oil and gas may accumulate in such a structure, the oil and gas being driven upward by water through the sandy strata until their progress is arrested by the flattened water soaked sand at the top of the terrace. There may be a slight reversal of the dip at the crown of the fold.

FAULTED STRUCTURES.

Any impediment which stops the progress of water, gas and oil through inclined porous strata may occasion remunerative accumulations of oil and gas. In some instances faults are impediments which produce oil pools. In Fig. 6, a gravity fault is represented as having produced such a result. On the down throw side of the fault the continuation of stratum AB had dropped to point D leaving the broken end of stratum AB abutting a stratum of impervious shale. The

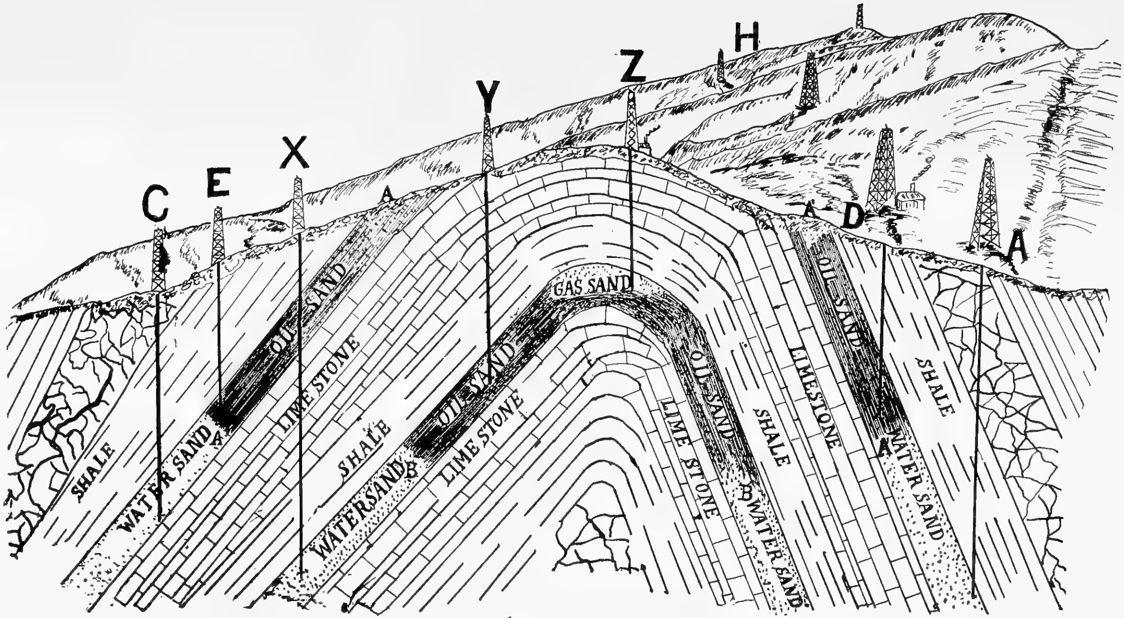


Fig 1.—Cross-Section of Oil Field Situated on an Anticlinal Structure.

water rising in stratum AB has driven the oil and gas into the upper portion of the stratum where they have arranged themselves according to their relative specific gravity. Unless the line of faulting is filled with lime or clay or other impervious material there would be an oil spring or asphaltum bed at point C—the probability is that most of the gas would have escaped along the fault line.

OIL POOLS FORMED THROUGH CHANGE IN PERMEABILITY OF STRATA.

There doubtless are instances where a change in the permeability of strata have occasioned oil pools or a variation in the yield of wells situated near one another, and the occurrence of dry holes in otherwise productive territory may often be attributed to this cause. In Fig. 7 stratum AB is shown to change from sand to clay and the oil and gas being pressed up by the water have percolated through the porous strata until they reached the barrier of clayey material in front of which they form an oil pool. It is evident that while C will be a productive well, D will be a dry hole.

The illustrations accompanying this article show types of geological structures which have been found favorable to the accumulation of petroleum.

The most important of these is the anticline, to which the greater number of the important oil fields of the world may be referred. When there are sufficient rock exposures in a locality the geologist can generally determine the character of the structure but of course it is impossible for him to demonstrate whether or not any particular structure contains an oil pool. He can, however, eliminate many of the risks of prospecting for oil by selecting territory where there are structures favorable to the accumulation of petroleum and where oil yielding horizons may be reached by the drill.

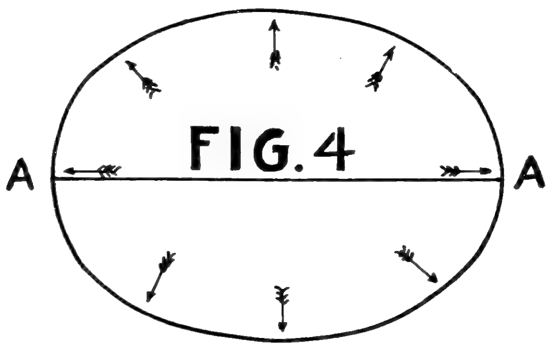


FIG. 4—CONTOUR SKETCH OF DOME.

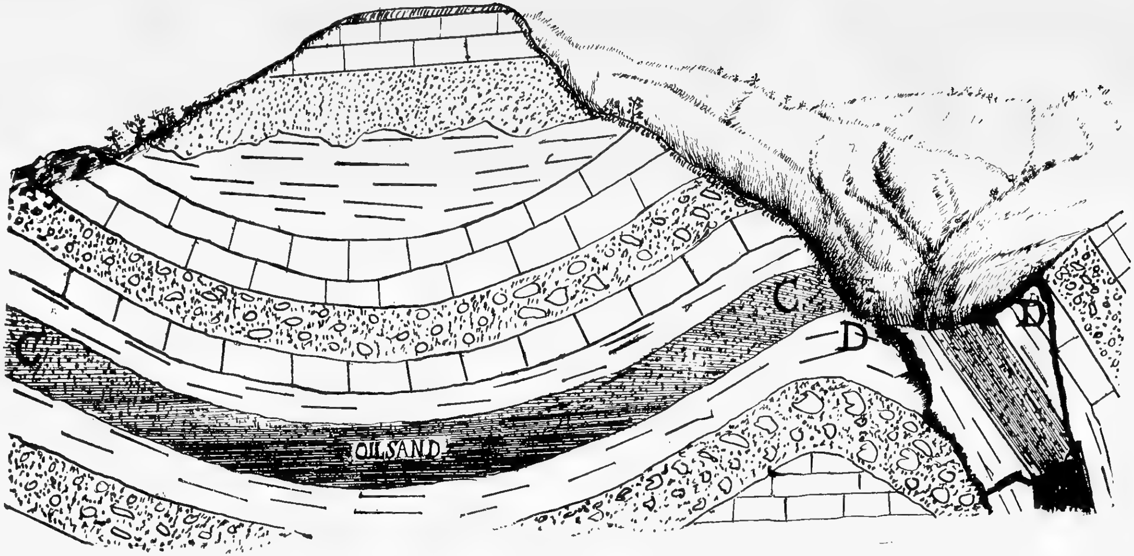


Fig. 2—Cross-Section Showing Synclinal Structure.

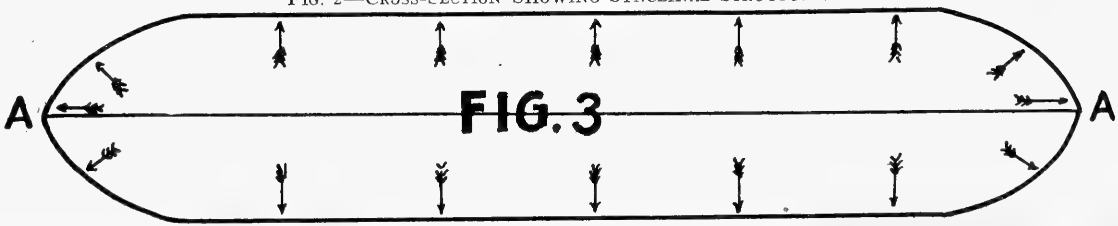


Fig. 3—Contour Sketch of Anticline.

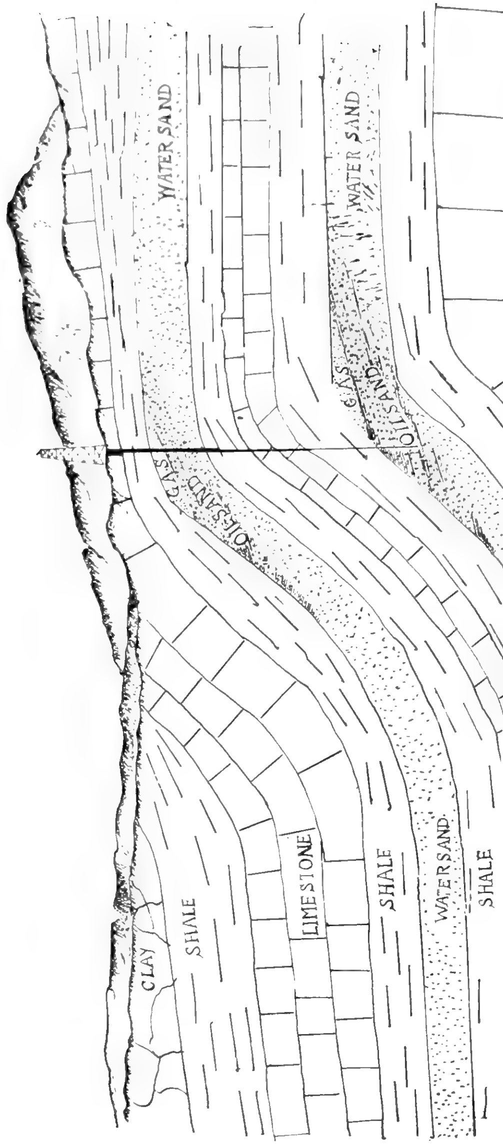


FIG. 5—CROSS-SECTION SHOWING TERRACE STRUCTURE.

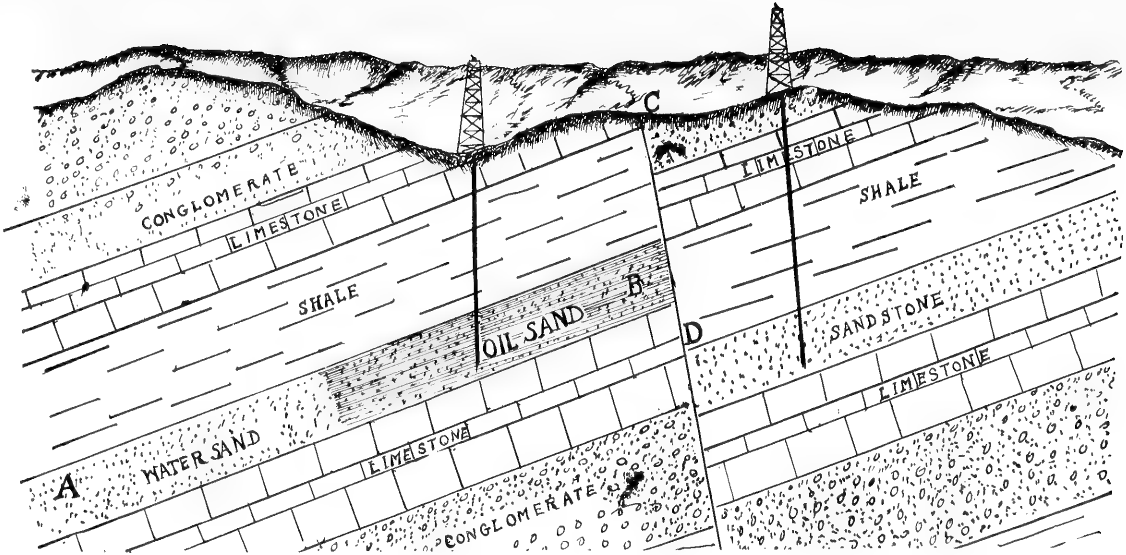


FIG. 6—CROSS-SECTION SHOWING OIL POOL FORMED BY FAULT.

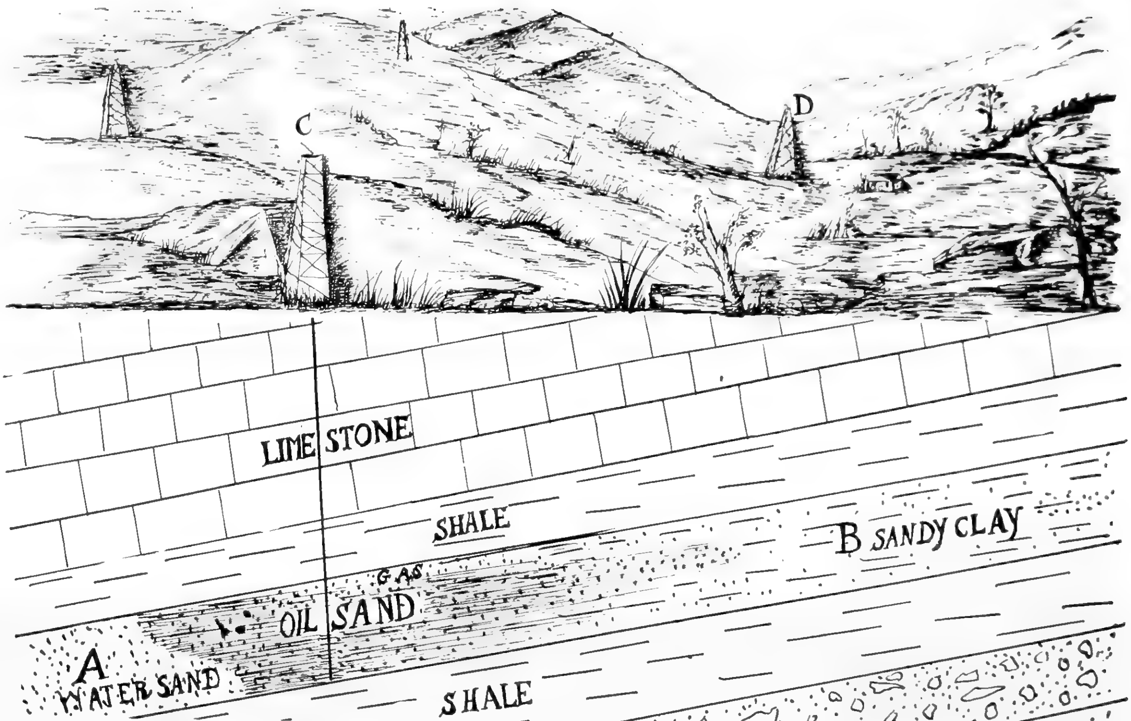


FIG 7—CROSS-SECTION SHOWING FORMATION OF OIL POOL DUE TO CHANGE IN PERMEABILITY OF STRATA.

APPLIED SCIENCE.

By Melville Dozier

The word "Science," as at present used, covers an immense field of thought and activity, much of it purely theoretical, but much more of it eminently and increasingly practical. It is only as science may be applied to the experiences and necessities of daily life that it reaches its heighest phase of usefulness; and, while the present is preeminently the age of applied science, the real progress of the age must be realized through continued and ever increasing advancement in the same direction.

One of the marked phases of applied science is the tendency of development of human control of physical forces for the accomplishment of many great ends and a vast multitude of smaller ends, undeniably connected with man's material needs, convenience and comfort.

It is only necessary to mention air, water, fire and electricity, to call to mind the almost countless applications of these mighty and limitless forces of nature to the ever recurring and ever increasing needs of man under the present and ever changing conditions of civilization.

The very conditions under which human beings are living will cause advancement along these lines to become both necessary and sure; sure because necessary; and there need to be no anxiety lest scientific research and scientific accomplishment shall not continue to attain higher and more marvelous stages of perfection.

But is it to these material and tangible things of life, as important as they doubtless are, that the application of scientific principles is to be limited?

What about the science of government and the science of business?

Progress along the so-called material lines above referred to but adds to the necessity of applying scientific principles to government and to business; since, because of the ever increasing complexity of human society, growing out of its ever increasing needs, which, in turn, are the results of its ever increasing aspirations, the establishment of scientific government and the application of equally and kindred scientific principles to commercial enterprises becomes essential to the conservation and proper use of all that is gained along the lines of national advancement.

One marked difference, however, between these two phases or fields of applied science is that one grows out of the human mind dealing with material, insensate things, subject to manipulation at will and obeying blind forces that work uniformly under fixed conditions; while the other is the human mind dealing with the human element, the spiritual nature, subject to every form of emotion, aspiration, desire and will.

Here is a world of difference, but a condition that requires no less the application of true scientific principles in order to gain the

ends of highest value.

Just at the present juncture in its history the world is in the throes of a marvelous metamorphasis in its forms of government.

The old and unscientific regime, where the will of one or of a favored few controlled the wills and destinies of the many is crumbling into merited dust, while the inherent equality of all men before the law, and the law the product of the united wisdom of the whole people, expressed directly or by proxy, is being recognized as the fundamental principle of human government the world over.

This principle once accepted and made the corner stone of human government, the problem of its scientific application so as to secure the highest good to the greatest number becomes one of the most profound and far-reaching problems that ever challenged the human intellect and has tested the highest faculties of mind and spirit of the most crudite scholarship and the most far seeing statesmonship. It appeals to the noblest attributes of the soul no less than to the greatest powers of mental discernment, and is thought by a large proportion of the world's population to have attained its nearest approach to perfection in the constitution of our own beloved country.

The recognition of the inherent rights of man and the establishment of institutions of government designed to conserve, to regulate and to perpeuate those rights has been the greatest gift of man to men in modern times, and grateful should we be that this exalted honor has been conferred upon the founders of the American government.

Its merits have endured the test of a hundred and forty-four years of varied history, and the world has accepted its claim to superiority over all other forms of human government in securing the maximum of liberty with the minimum of restraint.

Why should not the same principles of justice, co-operation, economy, energy and service be applied in similar form to smaller groups of men engaged in mercantile enterprises, the back-bone of the community, the vital source of its business prosperity and of its social peace and happiness?

If the plan works well in the great body politic and makes a happy and prosperous nation out of a hundred millions of human beings of varied ancestry, why should it not work even more effectively in a group of less proportions, of greater congeniality of sentiment and less diversity of character and purpose?

The manifest answer is that it would so work, and the selfishness of man has been the basic reason why this fact has not long ago been recognized and put into practice.

One of the happy omens of the future is that this principle of altruism, founded upon simple justice and mutual co-operation and profit is now being studied, advocated and even practiced by mercantile organizations which have come to recognize the fact that money making is not the only end in view in business enterprises;

but that the building of character, the harmonizing of human interests, the cultivating of mutual confidence and friendship and the establishment of the homes of the community in peace and affection, lie at the very basis of all real prosperity and permanent happiness and progress in our cities.

To bring about such results as these is not only one of the noblest motives that can actuate the heart of man, but it also requires a firmness of purpose, a keenness of intellect and the exercise of an unselfish spirit that would be worthy of the best and the noblest among us, and would do more in ten years to secure the real joy of living and to disseminate the good things of life, both material and spiritual, than has been accomplished in these directions during the centuries of the past. Is it not worth the trial? All honor to our business men who have seen the light and grasped the opportunity.

A SUPPLEMENTARY BIBLIOGRAPHY OF THE SOUTHERN CALIFORNIA FLORA.

By S. B. Parish.

Note. The bibliography to which this is a supplement was published in this Bulletin, Vol. 8, pp. 71-75, July, 1909; and Vol. 9, pp. 57-62, January, 1910. The territory there covered is here extended to embrace the counties of Santa Barbara, Ventura, Kern and Inyo.

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TRANSACTIONS OF THE ACADEMY

Director's Meeting.

A meeting of the Board of Directors was called by the President for September 27th, 1919; the following members being present:

Messrs. Collins, Davidson, Parsons, Keese, Low, Payne and Spaulding.

The names of Mr. James R. Townsend and Dr. Exilda J. Deau were presented for membership n the Academy and were duly elected.

The Auditing Committee reported that the Treasurer's accounts for the fiscal year 1918-19 were found correct, and thereupon were approved.

Bills of the Biological Section for meetings amounting to $9.16 were presented by Secretary Jewett and were ordered paid.

George W. Parsons, Secretary.

Meeting of the Astronomical Section.

October 10th, 1919.

Dr. George Wharton James of Pasadena, California, gave a most interesting lecture before this Section in the auditorium of the Central Intermediate High School to a large and appreciative audience, the subject being: "Romance of the Early History of California with Special Reference to the Indians."

The lecture was illustrated with beautifully colored stereoptican slides. Dr. James is a forceful speaker and gave many interesting incidents which occurred during his travels among the Indians.

Mars F. Baumgardt, Chairman.

Zoological Section.

This Section met on June 26th, 1919, in the Lecture Room of the L. A. Public Library. Dr. F. C. Clark gave a very interesting talk, the subject being, "Ancient History of Animals as Shown by the Infancy of The Present Forms."

Biological Section.

Meetings of this Section were held on the following dates in the Lecture Room of the L. A. Public Library. The lectures were very interesting and instructive.

Sept. 25th, 1919. An interesting lecture was given by Dr. Carle H. Phinney, the subject being: "The Vestigel Structure of The Human Body."

Oct. 25th, 1919. An interesting lecture was given by Mr. J. O. Beebe, the subject being: "Man and His Ancient Ancestors."

Nov. 29th, 1919. Dr. John Comstock gave a very instructive lecture, the subject being: "The Evolution of The Human Heart."

Dec. 15th, 1919. Talks were given by special speakers, the subject being: "A Review of Recent Scientific Discoveries."

Jan. 22, 1920. A beautifully illustrated lecture was given by Dr. M. B. Ketchum on the subject of the "Human Eye, Its Defects and Remedies."

R. D. Jewett, Secretary.

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Great Spiral Nebula, Messier 101. Photographed with the Telescope, Mt. Wilson Solar Observatory.

SPIRAL WONDERS OF THE UNIVERSE.

WILLIAM H. KNIGHT.

A PONDEROUS, highly-illustrated, quarto volume has just been issued by the Lick Observatory. A large section of it is devoted to that little-known but fascinating department of astronomical research—the Spiral Nebulae. These objects, so exceedingly small from a human point of view, were first classed among the nebulae because of their hazy appearance, but, as a matter of fact, they are not nebulae at all, but each is a great aggregation of suns, some of them comparable in extent with our own vast assemblage of suns, clusters, and the encompassing Milky Way, which we have been accustomed to designate the Siderial Universe.

Why are these objects called "spiral" nebulae? Because many of the nearer ones which come well within the range of our great telescopes, are seen to have spiral convolutions, as if, when undergoing the process of condensation into suns from the vast nebulous fields trillions of miles in extent, whence they were derived, they were whorled into a succession of rings, each smaller than the preceding, giving a pyramidal or cone-like effect.

There is another singular peculiarity frequently observable in the spiral nebulae. When seen edgewise they show a dark line running down the whole length of the spiral. This is generally explained as due to a band of absorbing or occulting matter. But the nature of this band, broad enough to be seen at this great distance, is a great mystery. It is again singular that these dark lines are most marked in those spirals which are apparently seen edgewise.

According to E. E. Barnard of the Yerkes Observatory, we have instances of occulting matter in certain regions of our Milky Way. These black spots were formerly regarded as holes, through which we could peer into vacuity, but there is now a consensus that these black patches are due to intervening, obstructing, non-luminous nebulae, which hide the stars beyond.

Many of these spiral nebulae may be in early stages of development, suns just emerging from formless chaos, surrounded by circling planets, and these all ablaze like miniature suns, as was the earth while its glowing igneous rocks prevented the enveloping aqueous vapor from falling in rain to fill the hollows of our present ocean beds. Doubtless other spirals are still further advanced to that stage which enables the planets surrounding their suns to become habitable worlds, thronged with intelligent beings, whose astronomers gaze with wonder upon our own mighty Gallactic system, and speculate upon the possibility of their habitability. The thoughtful mind reels with the mental pictures which overwhelm it.

Consider our Milky Way—an enormous assemblage of suns forming a stream of worlds extending clear round our celestial vault, a

portion of the way completely bifurcated. Suppose an astronomer, located on one of the worlds composing a spiral nebula, should point his telescope towards the so-called sidereal system in which our little earth is located, what would he see? He would behold a characteristic spiral nebula, so minute, in consequence of its vast distance, that he could only be assured that it was an assemblage of suns by analyzing the light that issued from it.

But the most astounding fact connected with the investigation of these spiral nebulae is their vast number. Mr. Heber D. Curtis, an astronomer engaged in this special line of research at the Lick Observatory, has charted 762 with the thirty-two-inch Crossley reflector. But it is now estimated that the total number of spirals which are visible in the sixty-inch reflector on Mt. Wilson and other large space-penetrating telescopes, will number 722,000, and it is possible that the new 100-inch instrument will bring the number up to 1,000,000.

in other words, that portion of boundless space which lies within the range of our great telescopes, is studded with a million mighty aggregations of suns, some of which are, in extent and diversity and novelty, of the order of our own grand Sidereal System. And it is believed that their distances from us range from 100,000 to 1,000,000 light years.

Now our brightest star, Sirius, is something more than eight light years distant; the familiar North Star is forty-six light years away; while the multitude of stars in the Milky Way dimly shine from distances varying from six to 10,000 light years.

Compare these figures with those of the nearest spiral nebulae, and the human mind, accustomed to the familiar distances traversed by steam on our globe, is overwhelmed with the vast magnitudes, inconceivable distances, and yet wealth of universes in that portion of limitless space which lies within the reach of the powerful instruments which have been recently devised by the genius of man.

Oh ye puny sons of men, striving to pile dollars upon each other, no matter how many handfulls of gold ye gather, your hands will loosen their grasp upon them in a few years, your names will sink into oblivion, and the astronomical ages will roll on through an endless eternity, unmarked by an iota of all your strivings. Is it not worth while to pause for a moment now and then, and catch an occasional glimpse of the innumerable worlds and suns and systems and universes that fill the unfathomable depths of space?

If the human intellect, that spark of the Divine mind, can compass these flights of thought and imagination, peer into the deep arcana of nature, grasp her profound secrets, and watch some of her wonderful processes of world-building, has it not a splendid resource well worth cultivating?

Spiral Nebula H. V. 24 *Comae Berenices*, Edgewise, Showing the Dark Band.
5 Hours Exposure. Mt. Wilson Solar Observatory.

VIBRATIONS WITHIN OUR KEN AND BEYOND.

J. A. Lighthipe.

It is a scientific fact that on a desert island in mid-ocean, miles and miles away from any human being, the waves breaking on a rock make no sound, also, that a fire on the top of this rock will give no light. This is because sound is simply a sensation produced on the drum of the ear by vibrations having a cycle of from about 16 to something like 30,000; also, light is a sensation produced on the retina of the eye by a vibration something like 45 octaves higher than this. To a deaf man there is no such thing as sound; to a blind man there is no such thing as light. With all vibrations we have a phenomena which we call resonance, that is, a certain similarity in rate. We pick up and respond to a certain rate of vibration. This is very marked in sound where a tuning fork at the end of a room will set another going at the other side, or the resonance of the piano strings responding when we sing a note to the piano. This is also illustrated by the childish play of "hollering down the rain barrel."

The vibrations which we call heat are about an octave lower than the vibrations which we designate as light waves. These can sometimes be lowered or raised, most particularly noticeable in the Welsbach burner where we raise the frequency of the heat wave an octave and it becomes luminous, or in fluorescence where we lower the violet note in the spectrum and it becomes luminous. Beyond this rate of vibration which we call light we run into the ultra-violet which we sometimes call chemical rays. In taking a long series of vibrations, perhaps of various shapes, it is astonishing how few of these vibrations are well known, since we can see for only about an octave and can hear for only about 12 octaves. We can feel the sensation of heat for probably about two octaves. In between these different periodicities we may discover facts in science of which we have little dreamed today. We know that the vibrations of electric waves are away below those of heat. This practice of "tuning in" has led up to some wonderful new inventions, for instance, with a properly adjusted spark coil and condenser we can set up vibrations in space to almost any periodicity we like. These vibrations do not affect our known senses in the slightest degree, but knowing that they are in the air, we can "tune in" by means of an antenna wire with adjustable condensers until we resonate in synchronism with the vibrations that are thrown out by the spark coil and condenser at some other place. With this apparatus we can readily detect a make and a break in the spark at the other end. This is the modern development of the wireless telegraph. The distance it can travel is absolutely unknown, as it appears to be a question of the power generated at one end. We know that we can send it around the world, and whether we can communicate with the fixed planets is simply a dream which may, or may not, come true. We have been mystified as to how ants com-

municate with each other. By personal observation we know that they do. They probably talk to each other in audible sounds beyond the 30,000 cycle, but they could not hear us talk when we are using a cycle below 30,000. There is one peculiarly notable fact and that is, when the vibrations run into a clean mathematical ratio like a common chord of say C, E, and G, and these are in the ratio of 4, 5, and 6, any vibrations of sound that are transmitted to our ear in this ratio are pleasing and are the dominant chords in music. Octaves above would be 8, therefore, 4, 5, 6, and 8 would be a handful of notes that makes the most harmonious sound in music. We run across the same phenomena in light, for instance, the green and the vermillion rays which the Chinaman uses in his decorations are almost a perfect fifth, but the red of the geranium and the bouganvilla produce a most horrible discord, not being mathematical to the eye. I am bringing this matter up perhaps for the moral end of this sermon. As I have stated before, we have an almost unlimited rate of vibrations that do not affect our known senses. Flammarion, the French astronomer, has advanced the hypothesis that perhaps a great many of these vibrations which we have been unable to study affect us mentally. This may be the beginning of the study of mental telepathy. Most of us have had some actual physical experience in this psychological study. Personally, I have had some very vivid experiences myself. When we get down to real scientific experiments we invariably feel that we do not know how to get at them. I believe the time is coming when these unknown effects of vibrations can be segregated and analyzed. We meet people, hear them talk, and are thrilled, and why we cannot explain. We have seen a whole nation change its idea from—"I did not raise my boy to be a soldier," to the slogan—"Treat 'em rough." This all in the course of a year, and brought about by an extensive propaganda that affects every human being. We have also seen epidemics of fear sweep over the country which is the real psychological reason why we have financial panics, people thinking and acting in mobs; strikes, labor unrest, these are but the forceful examples of waves of thought that are sweeping the country today and affecting all of our lives. In the future development of humanity it is not too much to hope that we can control the race, that we can "tune in" with what we want, or we can "tune out" from what we do not want. We speak of a salesman being successful, that he is a good mixer, which is another way of saying that he is a good synchronizer. This is a subject that may well be studied out and practiced. If a man has complete control of his thinker, he has cultivated the art of "tuning in" and can make anyone like him, and can bring people to his way of thinking. If he can think through the 4th, 5th, and 6th ratios, so as to harmonize with other vibrations, which may take long years of study and practice, he will find that it is just as easy for the people in the world to love each other as to hate each other and it is only a matter of every man adjusting his condenser.

WIRELESS TELEGRAPHY—X OCTAVES

Octaves	Wave Length Meters	Wave Length Feet	Frequency Thousands Per Sec.		References
				Note: The waves now used in wireless telegraphy vary from 100 to 10,000 meters in length making many more octaves in this division than are here shown.	
X	1720	5641			
1	1220	4000	246		
	860	2820			
	610	2000	492		
2	430	1410			
	305	1000	984		
3	244	800	1230	Waves of these lengths and longer are chiefly used in wireless telegraphy.	
	215	705			
4	107.5	352			1

HERTZIAN WAVES—FOURTEEN OCTAVES

	Meters	Ft. & In.	Millions Per Sec.		
1					
	53.75		9.84		
	30.48	100′			
2	26.87				
3	13.43				
	12.190	40′	24.6		
4	6.72				
5	3.35			These waves were chiefly used by Hertz in his experiments.	
	3.048	10′	98.4		2
6	1.68				
	Millimeters				
7	840				
8	420				
	304.8	1′	984		
9	210				
10	105				
11	52.5				
12	26				
13	25.4	1″	11811		
	13	.5″			
	6.5				
14				Shortest Hertzian waves measured by Lampa 1897.	
	4	.158″	75000		3

UNKNOWN RADIATIONS—FIVE OCTAVES

1		
	Microns	
	3280	
2	1640	Unknown Radiation.
3	820	
4	410)	
5	205)	

DARK HEAT OR INFRA-RED SPECTRUM—EIGHT OCTAVES

Octaves	Wave Length Microns	Wave Length Millionths of In.	Frequency Millions of Millions per Second		References
				Note: Paraffin, benzine and carbon bisulphide are transparent to *all* heat rays. Water is opaque.	
1	102.5				
	100	3937	3	Limit of measured heat rays.	4
2	67	2638	4.5	Limit of Ruben & Nichol's measurements, 1898.	5
	51.25				
3	30	1180	10	Heat waves of these values emanate from the earth.	6
	25.6				
	25	984	12	Sylvine in thin plates becomes opaque.	7

				Rock salt in thin plates be-	
	20	787	15	comes opaque.	8
				Langley's estimated limit of the	
4	18	708	16.6	infra-red solar spectrum.	9
	15	590	20	Langley's longest measured	
	12.8			waves.	10
5	11	433	27	Flour spar in thin plates be-	
	6.4			comes opaque.	11
	5.3	208	57	Actual limit of Langley's solar	
6	3.2			spectrum, 1888-1890.	12
				Ordinary glass ceases to trans-	
	3			mit.	13
				Heat waves photographed by	
7	2.7	106	111	Abney in 1886.	14
	1.6			Extreme red—sometimes visi-	
8	.8			ble to acute eyes.	15

VISIBLE SPECTRUM—A LITTLE LESS THAN ONE OCTAVE

General Limit of Vision

	Anstrom Units	Millionths of In.	Millions of Millions per Second		References
				Limit of perception of red to average eye.	16
1	7600			Red.	
	6700		389	Orange.	
	6500	26	461	Yellow.	
	5830	23.3	515	Green.	17
	5510	22	544	Peacock.	
	5120	20.5	586	Blue.	
	4750	19	632	Violet.	
	4490	18	666	Limit of perception of violet	
	4004	16	750	to the average eye.	
	3900			Extreme limit of visibility in	
	3600			acute vision.	18

ULTRA VIOLET SPECTRUM—TWO OCTAVES

Octaves	Wave Length: Anstrom Units	Millionths of In.	Frequency: Millions of Millions per Second		References
				Note: The disruptive spark spectra of iron and cobalt shows 80% of radiation with-	
	3600	14.4	820	in the limits of the bracket	
	3380	13.3	888	("Pfluger") Am de Phys (4)	
	3000	11.8	1000	13—P 890—(1904)	
1	2800)			Ultra violet begins (approxim-	
	)			ately)	
	2790)	11.	1075	Flint glass ceases to transmit	19
	2480)	9.76	1210	Stoke's limit of the solar spec-	
	2150)	8.46	1418	trum.	20
	)			Note: In Manila the limit was	
	2020)	7.95	1485	found to be 2190 A. U.	
	2002)			Light crown glass ceases to	
	1850)	7.28	1622	transmit.	21
	1800)			Ordinary clear quartz begins to	
	1700	6.69	1765	absorb.	
2	1500			Clear calcite in thin plates be-	
	1350			gins to absorb.	23
	1230			Miller's photographic limit.	24
	1000	3.937	3000	Stoke's limit of fluorescence.	25
				Limit of transparency of finest	
				quartz in very thin plates.	26
					27

		Limit of transparency of thin plates of fluorite.	28
		Estimated limit of waves photographed by Schumann, derived from Hydrogen spectrum.	29
	900	Ionization of air begins.	
	750	Observed by Lyman in Spectrum of Helium.	
	600		

UNKNOWN RADIATIONS—NINE OCTAVES

1	500 A.U.	
2	250	
3	125	
4	62.5	*Unknown*
5	31.25	*Radiations.*
6	15.62	
7	7.81	
8	3.90	
9	1.95	

X RAYS—X OCTAVES

	1.66 A.U	
1	1.5	
	0.976	X Rays from Nickel.
	0.619	" " " Rhodium.
	0.614	" " " Palladium.
	0.58	" " " Rhodium
	0.51	
	0.488	
	0.475	

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CHEAP WIRELESS TALK ACROSS OCEAN

SIGNOR MARCONI prophesies that in the immediate future conversations between Great Britain and the United States will be carried on by wireless telephones and that the price will not be more than 14 cents for one minute.

The great inventor said that he spoke direct to Canada from London and he added:

"It is only a matter of time when we shall be able to talk to New York from London. Already we have carried out many successful experiments between London and the Continent, and we hope that we shall be able soon to announce the installation of a world-wide wireless telephone system in all countries interested. Our plans are developing rapidly."

Transoceanic conversations will be carried on through an ordinary telephone, the exchange being connected with the wireless stations at the receiving end and the same methods will be followed.

Signor Marconi already has applied for permission to erect a station in Norway to demonstrate his ability to talk across large expanses of water.—*Telephone Engineer.*

HOW FLOWERS WERE NAMED

A GREAT number of flowers have been named from their appearance, and many, too, from their properties. The daisy is (as Chaucer has it) "the eye of day"—*i. e.*, the sun; the sun-flower is named from its rays of sunshine, yellow. There is also the moon-daisy; and from their fancied resemblance to a star we have such names as star-wort and star of Bethlehem. The geranium is the crane's-bill, the Greek word for a crane being *geranos;* and there are the crow-foot, snowdrop, auricula (or "little ear"), monkshood, foxglove (more correctly, folks' glove—the allusion being to the fairy-folk), the larkspur, the mimulus or monkey-flower; and, from their likeness to bell or cup, such names as harebell (not hair-bell), blue-bell, and buttercup. Some of these are named from the shape of the seed-case, as also are shepherd's purse and shepherd's needle.

From the form of the leaf we have bugloss (*bous glossa* in Greek, ox-tongue in English), dandelion (French, *dent-de-lion,* lion's tooth), hawk-bit, and colt's foot. The pimpernel, a corrupt form of "bi-pinel" (Latin, *bis* and *penna*), is the double-winged flower; periwinkle (Lat., *vincire,* to bind) is named for the same reason as the woodbine; the columbine bears some resemblance to the dove (*columba*). There are also the orchid and fumitory, the latter (*fume de terre*) said to be named from its abundance and perhaps its curly appearance.

From their properties, mostly medicinal, are named feverfew (*i. e.,* febrifuge), comprey (Lat., *con-feruere*), narcissus (narcotic), eye-bright (an eye-wash—"purging the visual nerve," according to Milton), wolf's-bane, flea-bane, hen-bane, nasturtium (nose twister), borage (from the Arabic, "father of sweat," a sudorific), honeysuckle, and lavender (used to scent linen fresh from the laundry).

Color gives their distinctive name to some, such as burnet (a brown flower), gowan or "gowlan" (a Norse word, the yellow flower), lilac (Arabic, blue), cowslip, dusty miller, and silver-weed.

A few are named from places or habitat, as candituft (Candia), London pride, Canterbury bell, anemone (from growing in places exposed to the wind), and wallflower (from growing on ruined walls). Cinquefoil, trefoil, milfoil (or yarrow), are named from the number of their leaves. A few have poetical names—forget-me-not, pansy (think of me), and speedwell.

Religion, or devotion to the Virgin Mary, has suggested marigold, rosemary (an adaptation), ladysmock(lady's bedstraw, and lady's fingers.

Lobelia, fuchsia, and camellia are named from botanists of the sixteenth century.—*J. L. R., in the Scotsman.*

ASTRONOMERS' VIEWS

Yerkes Professors Deprecate Sensational Reports of Planet Mars.

BY PROF. EDWIN B. FROST AND PROF. E. E. BARNARD
Astronomers of Yerkes Observatory
(EXCLUSIVE DISPATCH)

CHICAGO, April 22.—We comply with the request of the Los Angeles Times for a statement concerning the planet Mars, which is said to be of some public interest at present, because we are genuinely desirous that the public should be correctly informed concerning scientific matters and particularly those astronomical. We must, therefore, depreciate the publication of the sensational reports which are appearing so frequently concerning the planet Mars and the possibility of communicating with it.

If we think of the earth's orbit as a circle around the sun, then that of Mars would be drawn as an elongated ellipse outside the circle. It would evidently be nearer to the earth at some points than at others. If the earth and Mars are nearly in the same straight line from the sun and at the point where the orbits come closest together, then this least distance will be about 35,000,000 miles; but if the earth is on the other side of its orbit (on the other side of the sun) the distance will be vastly greater, on the average 230,000,000 miles.

At intervals of little more than two years the planets come into line in this way, and at intervals of fifteen years this occurrence will also be where the orbits are closest together. For this year the least distance to Mars will be 54,000,000 miles, on April 27; on March 20 it was 67,000,000, and on May 20 it will be 58,000,000 miles.

In view of these great distances, it will be clear to any intelligent person that nothing appreciable will be gained in distance by ascending four or five miles above the earth's surface. Even if we could reduce the distance by 20,000,000 miles, which we can do by waiting until August, 1924, the advantage would be slight, except in viewing the planet through a telescope.

If the decrease in the density of the earth's atmosphere were an argument in favor of making such an ascent, it should be recalled that wireless signals are transmitted through thousands of miles of the earth's atmosphere.

NO PROOF OF LIFE

It has not been proved that the planet Mars supports any form of intelligent life, such as that on the earth. On the other hand, the largest engineering operations that we have here would not be visible at such a distance with the greatest telescopes now in use.

If it can be established that stray wireless signals received at some stations are not due to sending stations on the earth, then it would be most natural to attribute them to the disturbances which are

frequently observed on the sun, other evidence of which we have in the auroral displays, and other magnetic influences which the sun produces upon the earth.

The planet Mars is a very interesting object to observe in a good telescope. The general surface is of a strong yellowish color, but there are large dark markings which are sometimes of a greenish color, and some parts of which are subject to probably a seasonal variation. There are also white polar caps; in the winter of the planet these extend down to middle latitudes, and in the summer melt to small size, which suggests that they are probably due to snow.

POLAR CAPS

In the south polar regions of Mars there seem to be mountain ranges. Their presence is revealed by the melting polar cap, which always leaves behind it at these places white strips that more slowly melt away. These white strips seem to be due to snow on considerable elevations.

The rotation of the planet can be seen readily, even in telescopes of four or five inches aperture, by watching it for a short time. This rotation is also clearly shown on photographs of Mars. The length of its day, from such observations, is about thirty-seven minutes longer than our day. Mars rises in the east at about sunset now. It can be readily recognized by its red color, and by being the brightest object in that part of the sky.

A VALUED MEMBER GONE.

Dr. F. S. Dagget, member of the Southern California Academy of Sciences, answered a sudden summons of death on the 3d instant.

Dr. Dagget, with his family, attended Easter services on the historic and picturesque Mt. Rubidoux, in Riverside, and shortly afterwards he was stricken, and died in Redlands the following day. The body was brought to Los Angeles, for funeral services and a final resting place.

Dr. Daggett leaves a family comprising his widow, Mrs. Lelia Axtenn Daggett, who resides at the home, 1333 Fifth Avenue, Los Angeles, a daughter, Mrs. Paul Stuart Rattle, of Cynwyd, Pa., and

two brothers in the East. He was born in Norwalk, Ohio, and died in his sixty-fifth year.

Dr. Daggett's specialty in science was ornithology, and in his years of active research he made a large collection of bird skins

representing practically every known species on the western continent, and many representatives from other portions of the world. This collection he loaned to the Museum of History Science and Art, at Exposition Park, over which he presided, and the valued exhibit, it is hoped, will remain there permanently. A small portion representing the best known and most interesting of our native birds, were mounted in groups, showing by environment their habits and habitats, so far as possible, and in handsome glass cases, they form a portion of the natural history exhibit which attracts universal attention. A large number of the skins still remain in cabinets, carefully classified, so that they are available for study, and may be mounted at any future time.

Dr. Daggett also gave much attention to lepidoptera, and some of the most beautiful cases of butterflies in the Museum are of his mounting.

Before coming to California about eleven years ago, he resided in Duluth, Minn., where he served as a member of the Board of Education and was Chairman of the Building Committee during the most active period of development in its public schools.

Dr. Daggett was essentially self-educated; he had a strong natural inclination to scientific lines, with especial leanings toward natural history, and was a devoted student all his adult life. The degree of L.L.D. was conferred upon him in later years for merit. He had a comprehensive grasp of many branches of science along general lines, and leaves a fine scientific library as attestation of his studiousness. As a profession he inclined to Museum work, for which his all-round reading and study eminently qualified him. He was well informed on the methods and collections of the Smithsonian Institution at Washington, the New York Museum, the Field Columbian at Chicago, and the Denver Museum. When he was called to take charge of the institution at Exposition Park about ten years ago he found an empty building, just erected, and a few unclassified and unarranged natural history collections to place in it,—some of them of the highest intrinsic value, but all needing co-ordination, mounting grouping and placing so that they might be available for the public. To this herculean task he addressed himself, and in less than two years the spacious building was filled to overflowing, having three general departments, as the name implies,—one devoted to Science on the lines of natural history, one to the Fine Arts, and one to History in ethnological and archaeological collections. There is also a good start towards a historical and scientific library. The Museum received as its greatest asset in starting the collection of pre-historic fossils from the Brea Beds in the environment of Los Angeles, which had been excavated, partially classified, and to some extent mounted by the South-California Academy of Sciences. With competent paleontologists under his direction, Dr. Daggett addressed himself to the task of overhauling a score or more of great boxes of unas-

sorted bones, some measurably entire, but the major portion in fragments, and all covered with a tenacious coat of brea. These had to be cleaned, the various fragments that belonged together selected from the jumbled mass; the various bones that belonged in an individual skeleton assembled and the whole articulated and mounted in durable form true to the plan of an animal that existed some two hundred thousand years ago, which has been extinct for untold centuries, and even the semblence to which the reconstructor may never have seen. A number of skeletons had thus been prepared by the Academy of Sciences, under the Manipulation of Prof. H. Z. Gilbert, and were thus turned into the Museum; Dr. Daggett took up this difficult task *in medias res,* and continued it until all the possibilities that lay in the jumbled boxes had been exhausted. Then he secured a concession from Mrs. Ross, the owner of the Brea Beds, and started on another series of excavations more exhaustive and more extensive than any previously performed. The result of this work, added to what had already been done by the Academy of Sciences, the University of California, the Los Angeles High School, and one or two other investigators, was sufficient to astonish the scientific world. It proved the Brea Beds to be the richest deposit of prehistoric remains ever discovered. About four hundred skulls of the Saber-tooth Tiger were taken out, and about an equal number of skulls of other mammals. Of course it was not possible to reconstruct from the broken mass complete skeletons for all of these skulls, but the representation as to types is believed to be very full. The collection includes, besides the Saber-tooth Tiger in all ages and sizes, the Imperial Elephant, the Mastodon, the Camel, the giant Ground Sloth, the Bison, the Wolf, the Coyote, the Horse (of prehistoric type), the Teratornis, a giant bird, larger than the South American Condor, and a considerable number of other animals. A number of new types were found. All the specimens identified were made subjects of careful study by scientists under special direction of Dr. Merriam, of the University of California, and a number of papers of the greatest scientific interest by Dr. Merriam and members of his staff, have been published by the University. So we may say that the scientific value of the wonderful deposits of the Brea Beds has been well exploited for the benefit of the world, and Los Angeles enjoys the distinction of possessing the only complete museum of these specimens. While the University of California excavated and still possesses a large number of these fossils they are not available at present for museum purposes.

In the tremendous scientific undertaking above outlined, Dr. Daggett took a large and important part, and his work in this is sufficient to carry his name down to posterity as a great public benefactor. In fact the entire Museum will stand as an enduring monument to his large grasp of matters of scientific, artistic and historical value, his great organizing ability, his indomitable energy and his single-minded devotion to a work of public beneficence.

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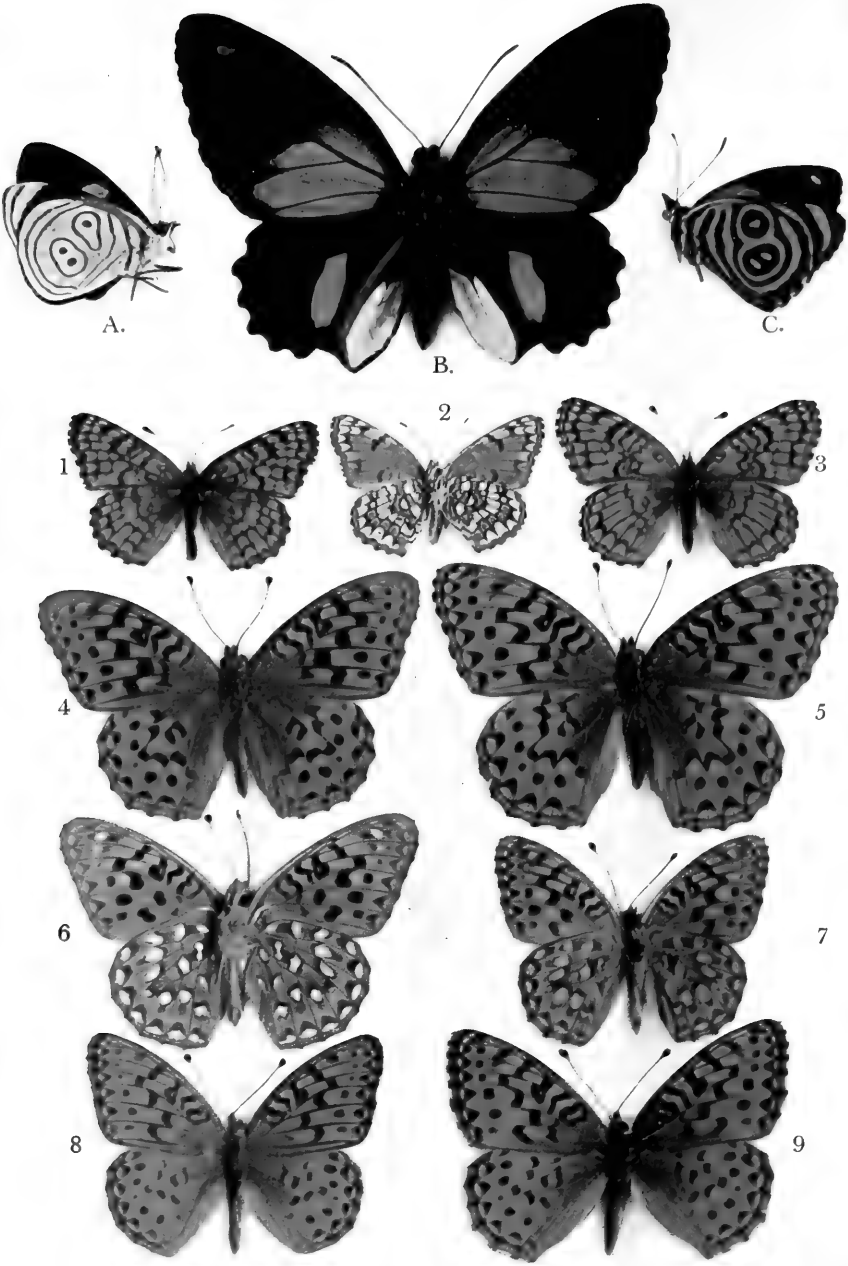

BUTTERFLIES OF CALIFORNIA

SEE PAGE 48

NEGLECTED FIELDS

Dr. F. C. Clark

NOTWITHSTANDING the extensive and careful work that has been done in many lines of scientific endeavor, there yet remains very much to be accomplished in all departments.

Even in those specialties in which the greatest number of workers are interested it must be admitted that only a beginning has been made.

It is with these thoughts in view that I wish to call the attention of the friends of the Academy and all lovers of nature to the great need of workers in all departments of scientific research.

Scarcely a day passes in which I do not have to give answer to some earnest inquirer about some bird, insect or flower, and while I am always glad to give the best reply possible to me, my learning has limitations, and only a few to whom knowledge is so welcome and so much needed, can possibly come within reach of the little help that I might give. Therefore, we see that the need of having persons in every community who shall be willing and able to render assistance is very great.

The spirit and purpose of the Academy is to accomplish this very thing and it is my intention in this sketch to call attention to the crying needs in the case and to suggest means by which the desired results may be accomplished.

I wish particularly to call attention to the very great cultural value of scientific study entirely apart from its economic or ultilitarian aspect. The finest poems in any language have to do with the things of nature, and the most nearly immortal of the poets are those who are in most perfect rapport with the fundamental principles underlying the things of the universe.

If we look at the matter from the viewpoint of a sound, dependable personality we cannot do otherwise than conclude that the most stable and perfectly balanced minds are those that are profoundly versed in the problems of science.

If we would wish to have the young men and women well balanced and rational we must ground them in the lines of thought that lead to that end.

Those who are doing the best work in any line are those who use the microscope as an aid to their natural vision and the instrument in question has led forward many a seeker for truth who might have given up the pursuit without the stimulus and added advantage of being able to see more clearly minute objects. The growth of the microscope has, in a large degree, kept pace with the development of science, for we could not make progress in some departments without it.

Any member of the Academy or any of our friends who wish to take up the study of any branch of microscopy will find one or more persons within the Academy who will take pleasure in rendering such aid as may be necessary in assuring them a good start.

What is true in this subject is equally true in any other branch of science. We wish to develop as many active workers as possible for we have a large work to do in the near future for the accomplishment of which we shall need the combined efforts of all who will labor with us.

We need more careful, scientific botanists, and there is no subject which affords a more delightfully invigorating avocation than this. Fortunately we have in our membership one of the very best botanists in the world, and his aid and counsel are available at all times and especially at the monthly meetings of the botanical section of the Academy. There are other thoroughly competent and genial men and women who are always ready to assist those who show a disposition to learn.

One of our recently elected members has vigorously taken up the study of vegetable galls and within a week after his election he had begun a collection of these wonderful little objects. We expect to hear from him in a very practical way in the near future. Would you not like to join him?

Vegetable galls are interesting for many reasons—partly because of the element of surprise that attends the study. You collect the galls and put them away in jars and await the emergence of the little creatures that produce them. You will often be surprised with the results.

Among the insect agencies producing galls there are to be mentioned beetles, flies, wasps, bugs and moths. Other galls are caused by tiny worms like the vinegar eels; others by fungi and still others by mites.

The material for this study is everywhere to be found and you can get enough in a single day to make a good working collection.

The study of butterflies has been carried on to a great extent in our country, but at the present time the life histories of a large number of them are not known. It is quite within the realm of possibility that you may add some interesting and valuable facts to our present knowledge of butterflies.

What is true of the lepidoptera is equally true of all the rest of the insect world, and in some cases the information that you and I might collect may be very greatly needed in saving crops or forest trees from destruction. The study of birds has developed to a wonderful degree and it is reasonable to suppose that there are no birds in the United States that have not been discovered and classified. Still there remains a vast amount of work to be done in ornithology. Some workers have been very painstaking in their efforts to know the internal structures of birds, and they have accomplished wonders. Among these are Dr. R. W. Shufeldt, Mr. C. W. Beebe and our own beloved townsman, Dr. L. H. Miller. These men have advanced our knowledge of the osteology of birds immeasurably and it is along this particular line that we need patient and competent workers. In my collections I have a number of nestling birds, both wild and domestic. These, together with some embryonic material, I expect to work up

in the hope of deciding some questions of variation of species that, so far as I know, are not yet known. I shall be glad to have help in this matter.

Most of us can tell meadow lark from a black bird when we see them in the field; but could we tell the skeleton of one from that of the other?

What I have said, as to our knowledge of several branches of the animal kingdom is probably true of all other branches. We need more knowledge. We must remember that there is an economical side to this question as well as the side that we are accustomed to call scientific. Vigorous, progressive commercial interests are looking for men who have an insight into the problems of biology and chemistry, for their success depends upon such men.

The opportunity is open to any who may have energy and foresight enough to cause them to enter.

The Southern California Academy of Sciences stands ready to give assistance to any who may be in need of it.

I take this occasion to thank the members of the Southern California Academy of Sciences for the honor they have done me in making me president and I trust that they shall not be disappointed in the choice.

There is a feeling of enthusiasm among the men and women of the Academy with whom I have talked and I predict a year of unprecedented progress.

Two facts seem to stand out with peculiar prominence and these are the need of a greatly increased membership and of some definite, systematic work on the part of the older members to help those of less experience in the ways of fundamental, constructive thinking.

Some members have been doing this regularly for years and will still work along this line; but there is need for more such effort by more people.

We expect the fullest and frankest and happiest cooperation in all sections of the Academy and we hope to accomplish great good in the matter of the dissemination of knowledge among men.

BUTTERFLIES OF CALIFORNIA.

Preliminary Announcement.

The need of an illustrated work on the butterflies of California, prepared in popular form, has long been felt by nature students and teachers throughout the state. The subject has always held wide popular interest, each community having its enthusiasts. Progress in the study has been hampered by the dearth of popular literature such as exists in the European countries, and the far eastern states. A few books have been issued that in some measure help to fill this want, but for the most part they are either too technical or expensive to interest the amateur, or they cover too extensive a field to be of real value.

The writer proposes in subsequent issues of the "Bulletin" to illustrate all of the butterflies occurring in California, properly grouped and named,—and to give such information concerning each species as will be of greatest interest to the nature student.

This material will be arranged in such form as that "he who runs may read." Scientific verbiage will purposely be held in the background, each species being entered under its common name and shown in accurate colors. The illustrations for this work will be executed in the three-color copper-plate process, as exemplified in the fronticepiece of this issue. The plates for this work are being prepared in Los Angeles under the direction of Mr. Raymond Thorpe. They represent the highest expression of this form of reproductive art. Through their use it will be possible to identify any specimen captured in the state at a glance.

It is hoped that this work will stimulate the study of this most fascinating branch of the natural sciences, and bring new recruits into the Academy's "Outdoor Army."

California is unusually favored as an environment for this study. Within its confines are found nearly two hundred and fifty distinct species of butterflies, not counting the many interesting varieties, local races, and aberrations. The diversity of our cultivated flora gives a footing for many introduced species. Our isolated mountain ranges have developed extremely local forms. In a word, California has compressed in its confines the elements of an entomological empire,—a veritable "happy hunting ground" of the butterfly enthusiast. butterfly enthusiast.

Explanation of plate No. 1:

Fig. A. Callicore euclides, from Colombian Republic.
Fig. B. Papilio oedippus, from Colombia.
Fig. C. Catagramma denina, Colombia.

The three upper figures illustrate some of the brilliant colors occurring in tropical species of butterflies.

Fig. 1. The Sabina Checker-spot (Melitaea sabina, Wright). Southern Arizona, male.
Fig. 2. Same, underside.
Fig. 3. Same, upper side of female.
Fig. 4. Malcolm's Fritillary (Argynnis malcolmi, Comstock). Mammoth region, California. Male.
Fig. 5. Same, female.
Fig. 6. Same, underside of male.
Fig. 7. The Tehachapi Fritillary (Argynnis tahachapina, Comstock). Tehachapi Mountains, California. Male underside.
Fig. 8. Same, upper side.
Fig. 9. Same, female.

JOHN A. COMSTOCK.

TRANSACTION OF THE ACADEMY OF SCIENCES.

DIRECTORS' MEETING.

A regularly called meeting of the Directors was held on May 13th, 1920, in the office of the Academy. There being a quorum present, the meeting was called to order.

Thirty new names were presented and elected as active members of the Academy.

Mr. William F. Alder who has just returned from a Scientific expedition through the South Pacific Islands was present, and presented to the Academy a valuable and unique collection, portraying the ethnology of the tribes in the isolated regions of those Islands. An expression of appreciation and cordial thanks for this generous endowment was given him.

DIRECTORS' MEETING.

A regular meeting of the Directors was held on Tuesday, June 8th, 1920, in the office of the Academy.

Directors present: Messrs. Baumgardt, Benton, Parsons, Keese and Collins.

Mr. William F. Alder, Dr. F. C. Clark and Dr. John Comstock were in attendance as invited guests.

The Treasurer was authorized to change the condition of the investment with the Mortgage Guarantee & Trust Co. for the best interests of the Academy.

Mr. Alder gave a very interesting account of the ethnological collection which he presented to the Academy. In appreciation of the valuable work that Mr. Alder has done for the Academy, he was unanimously elected a Fellow and Honorary Member of the Southern California Academy of Sciences.

Dr. Comstock kindly offered to store and care for the Academy's collections in a room at the Southwest Museum until such time as we are ready to place them in a building of our own.

ANNUAL MEETING.

The Annual Meeting of the Academy of Sciences was held on June 10th, 1920, in the spacious rooms of the City Club. A large assembly of members and guests were present who participated in a banquet prior to the regular business of the Academy and the program which followed.

The President gave a short statement of the activities of the Academy during the last year, after which the Secretary presented his Annual Report. Upon motion of a member, the old Board of Directors was elected to serve for the ensuing year.

The program for the evening consisted of violin and vocal music, followed by a lecture by Prof. B. R. Baumbardt who gave a very interesting description of the Yellowstone National Park which was illustrated by beautifully colored lantern views upon the screen.

DIRECTORS' MEETING.

A meeting of the Directors elected at the Annual Meeting was held on June 17th, 1920. Messrs. Baumgardt, Benton, Davidson, Collins, Keese, Parsons, Payne and Spalding being present.

A feeling was expressed by a number of the older members of the Board who have served for many years as Directors, that it was due the younger members of the Academy that THEY should be given a place on the Board and continue the work that had been done in the past.

After due deliberation, the following Directors tendered their resignation: A. B. Benton, S. J. Keese, Dr. T. C. Low, Geo. W. Parsons.

The resignations of Dr. Low and Dr. Benton were accepted, Dr. John Comstock and Dr. F. C. Clark being elected Directors to fill the vacancies. The resignations of Keese and Parsons were laid upon the table.

Dr. Anstruther Davidson and Dr. A. B. Benton were elected representatives of the Academy upon the Board of Governors of the Museum of History, Science and Art.

The Board adjourned to reassemble June 24th at 11 o'clock A.M.

DIRECTORS' MEETING.

An adjourned meeting of the Southern California Academy of Sciences was held at 11 A.M. on Thursday, June 24th, 1920, at the usual place for the

purpose of electing officers for the ensuing year, and to transact such other business properly coming before the meeting.

Directors present: H. O. Collins, Dr. Anstruther Davidson, Dr. F. C. Clark, Wm. H. Spalding, Theodore Payne, Dr. John Comstock, Geo. W. Parsons, S. J. Keese.

There being a quorum, the Directors proceeded to the election of officers. Dr. John Comstock nominated Dr. F. C. Clark for the presidency, and was seconded by Mr. Spalding. Dr. Clark was unanimously elected, and thereupon occupied the chair. Other officers were elected as follows: Vice President, Mars Baumgardt; 2nd Vice President, Dr. John Comstock; Treasurer, S. J. Keese; Secretary, Geo. W. Parsons.

The resignation of H. O. Collins as President, Director and Member of the Academy was upon motion accepted. Dr. Ford A. Carpenter was elected a Director to fill the vacancy caused by the resignation of Mr. Collins.

A suggestion was offered that an Advisory Board be created, selected from the members of the Academy, to act unofficially with the Board of Directors on any matter of interest to the Academy that might arise.

Mr. W. F. Alder who was present proposed to make an additional trip to the South Pacific Islands in the near future, and made a proposition to the Academy that in consideration of being allowed to use the name of the Southern California Academy of Sciences in connection with this expedition, he would collect further objects of interest and present them to the Academy upon his return. The matter was favorably received.

President-elect Clark, then gracefully accepted the Presidency and presented new ideas which should prove of great value to the Academy.

A motion prevailed directing that all available funds in the hands of the Treasurer be invested to the best advantage. The meeting then adjourned.

GEO. W. PARSONS,
Secretary

TREASURER'S REPORT

FISCAL YEAR ENDING MAY 31, 1920.

RECEIPTS:

Bank balance June 30, 1919		$ 67.72
Dues from Members		342.90
Interest from Loans		588.88
		$999.50

DISBURSEMENTS:

Bulletin Expense	$307.85	
Lecture	122.25	
Rent of Office	82.50	
Telephone	68.05	
Printing	31.60	
Postage	7.19	
Sundries	16.17	
Total disbursements	$635.61	
Cash in First National Bank May 31, 1920	363.89	
	$999.50	

Investment account balances.

Mortgage Guarantee Bonds at 5½%	$ 5,200 00
Fidelity Savings & Loan Stock at 6%	3,100.00
3rd Liberty Loan at 4¼%	2,650.00
4th Liberty Loan at 4¼%	200.00
	$11,150.00

S. J. KEESE, Treasurer.

ASTRONOMICAL SECTION

A GREAT TRIPLE SUN

Recent Researches in the Gigantic Stellar System of Lambda Tauri

WM. H. KNIGHT

THIS noble object, an eclipsing variable, is to the unaided vision a star of the third magnitude, just below the Hyades in the constellation Taurus. The great red star Aldebaran, recognized as the angry eye of the Bull, is at the top of one stem of the letter "V," which forms the Hyades group. It is worth while to note that Lambda Tauri is, next to Algol, the most conspicuous eclipsing variable in the heavens.

This interesting star has long been an object of earnest inquiry, for its normal brightness is diminished by two minima. That is, its light wanes with unceasing regularity once in about four days; to be exact, at the end of every 3.95 days. The decrease is not much, but it is as invariable as the succession of day and night on our globe. The cause of this diminution of light was an insoluble mystery 'till the spectroscope in the hands of Belopolsky at the Pulkowa Observatory in 1897 showed that this fine star, a single point of light in the most powerful telescope, consists of two mighty suns revolving round a common center of gravity with enormous velocity, the plane of the orbit being presented nearly on edge to our vision.

At each revolution the smaller of the two bodies, known as the companion, and less bright than its primary, passes between the observer and the primary, partially eclipsing it, and thus causing a diminution of the light of the two bodies. This is a rational and satisfactory explanation of the four-day phenomena.

But the behavior of Lambda Tauri is complicated by another and less notable minimum which occurs once in thirty-four days. It is as insistent as the four-day period, but less pronounced in the diminution of light. How to account for that has been the puzzle, but a satisfactory explanation has recently been offered by Schlesinger of the Allegheny Obesrvatory. He assumes that there is a smaller body revolving round the gigantic binary in a period of thirty-four days, and this body, passing between the eye and the binary every thirty-fourth day, would fully account for the slight but unfailing diminution of light observed. Is not that a striking case of "the astronomy of the invisible" asks Joel Stebbins of the Illinois Observatory, who has been making a study of this interesting variable.

And now the question arises, what are the dimensions of these great suns, so far out in the depths of space that no astronomer has been able to measure their parallax? Spectrum analysis again comes to our assistance and furnishes a solution. This Rosetti stone of astronomical science shows the velocity of the approach or recession of a star in the line of sight. Knowing that velocity we measure the dimensions of the orbits traversed by the two suns, and thence make an approximate estimate of the bodies moving in those orbits.

The dazzling splendor of the two bodies forming the eclipsing

variable, Lambda Tauri, may be inferred when I state that the diameter of the primary is placed at 4,250,000 miles, or about five times that of our own sun, while that of the companion is 3,200,000 miles, or three and a half times that of our sun. Accordingly the volume of the primary is 110 times greater than that of our sun, and that of the primary is 47 times greater.

But after all these vast worlds are only magnificent balls of gas, for the mass of the primary is only equal to two and a half times that of our sun, while its companion is barely equal to our sun in mass.

VARIABILITY OF SUN'S RADIATION.

Mr. C. G. Abbott of the Smithsonian Astrophysical Observatory gives an account of the results of investigations on the variability of the sun's radiation in a paper published in the Proceedings of the National Academy of Sciences for February, 1920. It is found that the investigations of the Smithsonian Astrophysical Observatory conducted at Washington, Mt. Wilson, Mt. Whitney, Bassour (Algeria), and now the investigations supported by the Smithsonian Institution from its private funds in North Carolina and Chile have all united in giving the impression that the solar radiation is not constant, but varies from day to day through a range of certainly five, and possibly at times ten per cent. The conclusion that the sun is a variable star is confirmed in several ways, but most notably by the results of measurements made by the Smithsonian Astrophysical Observatory at Mt. Wilson, California, on the distribution of energy along the diameter of the solar image. These measurements indicate, as well known before, that the edge of the sun's disc is less bright than the center, and that the contrast of brightness between the center and the edge varies according to the wave-length of light, being greater for short wave-lengths, less for long.

But the measurements of recent years have shown that not only is there a variation of contrast by wave-length, but also a variation of contrast with the time. The contrast in each wave length is different for different days of observation and, on the average, for different years of observation. The changes of contrast have been compared with the changes of total radiation of the sun determined by the aid of the Pyrheliometer and spectrobolometer, and it is found there is a moderate degree of correlation between them. The correlation is of two kinds. For variations of long periods of years, high values of the solar constant are found associated with the high values of contrast between the center and edge of the sun. On the contrary, for the short period variations of the solar radiation, occupying a few days, weeks or months, it is found that high values of the solar radiation are associated with diminished values of the solar contrast.

The cause of this two-fold variation is reasonably explained. When the sun grows hotter and thus increases its output of radiation

along with increased solar activity, as indicated by sun spots, prominences, and other visible solar phenomena, this would tend to cause a greater degree of contrast. For since if the solar temperature were zero there would be zero contrast, the higher the temperature the higher the contrast. But the sun is probably entirely gaseous, and certainly its outer layers are so, and these may become more turbid at times, just as the earth's atmosphere becomes more hazy at some times than at others. Accompanying increased turbidity of the solar atmosphere there would be found a diminished value of the solar constant of radiation. But since the path of the solar ray is oblique in the solar atmosphere near the edge of the sun, the path is longer there and the effects of the turbidity would be greater at the edges rather than at the center. Thus with the increase of turbidity the contrast of brightness would increase accompanying a diminished value of the solar constant of radiation. In this way it appears that the two-fold variations of the sun which have been found may be reasonably explained.—*Scientific American Monthly.*

Mr. William F. Alder, lately returned from an ethnological expedition in the Orient and the South Sea Islands, lectured before the Academy of Sciences and guests, at the Chamber of Commerce Hall on the evening of Friday, July 30th. The auditorium was filled to overflowing and the audience was well entertained by Mr. Alder's chatty narratives of some of his experiences on the trip. He utilized the screen to present some interesting pictures, illustrating types of people encountered among the head hunters of New Guinea and Borneo, their strange manners and customs.

Mr. Alder left August 2nd with the expedition of the Southwest Museum under the direction of Dr. Edward D. Jones, to gather specimens of the fauna of the far North. Mr. Alder will confine his attention to making moving picture films and photographs for the Academy of Sciences.

BOTANICAL SECTION.

THE botanical section have held their meetings regularly on the fourth Thursday of every month throughout the winter. Due to the active enthusiasm of numerous new members the meetings have been of more than usual interest and the wealth of material presented has been so great that the proceedings have been limited to the examination and identification of the specimens collected. A notable feature was the exhibit of many specimens of lilies and other northern plants cultivated by Mr. R. Kessler.

Some of the results of the work of the session are here presented.

NEW OR NOTEWORTHY ADDITIONS TO THE FLORA OF S. CALIFORNIA.

CAMELINA SATIVA, Crantz. Roadside at Glendale, *Mrs. H. H. Rockwell.* An old world weed of grain fields, reported by *Jepson* from Siskiyou Co., and Berkeley.

LUPINUS AGARDHIANUS Heller (L. gracilis Agardh.) This plant is probably not so rare here as the published reports would indicate. In its vegetative characters it so closely simulates *L. micranthus* that it is readily overlooked. It has been gathered this season on hills near Fullerton by *Mrs. H. H. Rockwell* and at Glendale; Santa Susanna Pass; and hills north of Newhall by the writer.

SILENE CALIFORNICA Durand, a common plant in the northern coast ranges, but not hitherto recorded from southern California, has been found growing abundantly in Pico Canyon by *Mrs. W. W. Hutchinson.*

POLYGALA FISHIAE Parry. Growing abundantly at Crater Camp in the Santa Monica Range, *T. Payne;* Santiago Canyon and canyon near Laguna, *Miss Thecla Mohr.*

GILIA SETOSISSIMA T. & G. Miss Milliken in her "Revision of the Polemoniaceae" anticipated the discovery of this species in California. *Parish* has since reported it from Palm Springs and this season *Mr. K. R. Coolidge* has brought in a few specimens from near Mecca. The corolla is pinkish streaked with darker lines.

LINARIA DALMATICA Mill. Discovered by *Robert* Kessler about a mile from Sturtevant's Camp, San Gabriel Range, the first record of its discovery in the United States.

BRODIAEA LACTEA Wats. Luxuriant specimens of this species was found in the brush near Camp Baldy by *Miss Jessie A. Potter.*

ALLIUM ATTENUIFOLIUM Kell. Ivy Canyon, Temescal, *Miss Thecla Mohr.*

EURYPTERA PALLIDA C. & R. Mountains west of Tehachapi. The only other record of this species is that from the type locality, the Santa Lucia Mts. Identified by P. C. Standley.

HOLOCANTHA EMORYI. The following note has been received from David G. Thompson, Associate Geologist, Dept. of the Interior, Washington:

"I have recently read a note by Roxana Stinchfield Ferris, in the

January, 1919, number of the Bulletin of the Southern California Academy of Sciences, describing the occurrence of Holocantha emoryi near Ludlow, California. Inasmuch as this species seems to be very rare in California it may be of interest to record the occurrence of this peculiar plant at two other localities that have come to my attention.

In February, 1918, a prospector gave me a specimen of a plant that was unknown to either of us. He had obtained it in the wash of a long broad valley that extends from the vicinity of Goffs, on the main line of the Atchison, Topeka & Santa Fe Railway, in San Bernardino County, southward to Ward station on the branch line of the same railway from Cadiz to Parker. The locality was given as about 20 miles south of Goffs. The specimen was sent to Miss Alice Eastwood of the California Academy of Sciences, at San Francisco, who identified it as Holocantha emoryi.

In December, 1919, I was shown a specimen of the same plant by another prospector who had obtained it along a road that leads southward from the National Old Trails road about 25 miles west of Ludlow. This locality is west of the one mentioned in the Bulletin.

I may state that I have traveled all of the important roads of the desert in San Bernardino County in connection with field work locating desert watering places, and I have never seen Holocantha emoryi growing."

COLLINSIA CONCOLOR Greene. This species originally described by Greene from specimens collected in southern San Diego Co., has been found growing in great abundance near the top of Pacoima Canyon, Los Angeles Co., by *C. J. Marvin*. While some other Collinsia may show somewhat villous calyces the calyx segments in this species are comparatively large and the filaments may be classed as glabrous as only a few microscopic hairs are to be found near their base.

ALLIUM MONTIGENUM N. SP.

Bulb about 10 mm. in diameter, without definite reticulation; leaves 2, 10-12 cm; long, linear and withering early; scapes 1-2 dm. high, terete and finely striate when dried; bracts 2, broadly ovate with an abrupt acuminate tip 5 mm. long; pedicels 12-18 on pedicels 1-2.5 cm long; perianth segments pink to dark reddish purple, 12-15 mm. long, and 5 mm. wide near the base, all lanceolate acuminate but the inner 3 slightly narrower below and longer acuminate above; stamens and filaments 10 mm. long; filaments not deltoid; capsule shallowly 3-lobed, without crests, the central depression between the lobes usually purple tinged. Common on canyon slopes in the San Gabriel and San Antonio Mts. No. 2974, Coldwater Canyon, San Gabriel Mts., type in the author's collection.

This is a well known plant and has heretofore been distributed as *A. Parishii* or *A. Breweri,* but it differs from both in the capsules and in the perianth which in this species is comparatively very long. The

color varies somewhat with the altitude specimens brought by *Burlew* from Mt. San Antonio are a very dark purple while those in the chaparral zone are of a lighter color and are sometimes pinkish.

NOTES, CHIEFLY NOMENCLATORIAL, ON SOUTHERN CALIFORNIA FERNS.

George L. Moxley.

WHILE making a somewhat extended study of our Southern California Ferns a number of interesting items have come to my attention, some of which it has seemed worth while to pass along. These deal for the most part with the changes of names and the extensions of range of the ferns found in our region.

It has been shown by Maxon (Contrib. U. S. Nat. Herb. 17:173. 1913.) that our Goldback ferns, heretofore referred to Gymnogramme, Gymnogramma or Gymnopteris, should properly be called Pityrogramma Link. Our species therefore should be known as:

Pityrogramma triangularis (Kaulf.) Maxon. *Gymnogramma triangularis* Kaulf. Enum. Fil. 73. 1824.

Pityrogramma viscosa (D. C. Eaton.) Dixon. *Gymnogramma triangularis viscosa* D. C. Eaton, Ferns of North America 2:16. 1880. *Ceropteris viscosa* Underwood. Bull. Torrey Club 29:631. 1902.

Notholaena cretacea Liebm., reported from San Diego County in Underwood's Our Native Ferns, is shown (Contr. U. S. Nat. Herb. 17:601-604) to be an aggregate of three species. N. cretacea Liebm. is confined to Mexico, N. neglecta Mavon, n. sp., is found in northern Mexico and southeastern Arizona, and N. californica D. C. Eaton is found in Southern California, Arizona and Lower California.

In the American Fern Journal 7:106-109, 1917, the same author shows that our southwestern fern known as Notholaena tenera Gillies is not conspecific with that South American plant. He therefore describes it as N. jonesii, taking as his type a plant collected by Marcus E. Jones in Panamint Canyon, Inyo Co., Calif., May 4, 1897, and citing two collections by Parish near Cushenberry Springs, San Bernardino Co.

The range of Cheilanthes feei Moore has been considerably extended by the recent record of Parish, who reports it from Providence Mts., San Bernardino Co. (Bot. Gaz. 65:334. 1918.. Mr. Maxon also cites a collection of this plan at Mountain Spring, western border of the Colorado Desert, San Diego Co., May 12, 1884, *Internat. Bound. Comm.* 3080 (*Schoenfeldt* col.). Its range was previously given as Illinois to Texas, Arizona and British Columbia.

Another fern that has puzzled the writer has been referred variously by collectors to Cheilanthes myriophylla Desv., C. clevelandii D. C. Eaton and C. fendleri Hook. At my earnest solicitation Mr. Maxon made a study of the material of the various forms in the National Herbarium and undertook to clear up the status of these forms. C. myriophylla Desv. was described from South American material and very likely does not reach the borders of the United

States. C. fendleri Hook. is a species of Texas, New Mexico, Arizona and Colorado. C. clevelandii D. C. Eaton was described from specimens collected "on a mountain about forty miles from San Diego, California," by Daniel Cleveland in 1874. The common form of our mountains has been described as C. covillei Maxon, and ranges from Lower California to Inyo Co., northern Arizona and Nevada (Proc. Viol. Soc. Wash. 31:139-152. 1918.).

The fern commonly known among us as Pellaea ornithopus Hook. is shown by Maxon (Pros. Biol. Soc. Wash. 30:179-184. 1917.) to be P. mucronata D. C. Eaton. He also considers three species, hitherto passing loosely as P. wrightiana Hook., one of which, P. compacta (Davenp.) Maxon, is found in our region, having been collected in the San Jacinto, San Bernardino and San Antonio Mts.

Our Californian Woodwardia should be known as W. chamissoi Brack. W. radicans (L.) Sm. has been shown to be an Asiatic species, and W. spinulosa Mart. & Gale., to which our fern has frequently been referred, is a Mexican species which does not reach our borders. The fronds in our species are stiffly ascending from an oblique or erect rhizome while those of W. spinulosa are lax from a short-creeping or decumbent rhizome. They also differ in the shape of the blade, position of pinnae, the venation of the pinnules and the characters of the indusia, according to Maxon (Am. Fern Jour. 9:68-69. 1919.).

There has been considerable controversy among systematists as to the proper generic mane for our shield ferns. Nieuwland has shown (Am. Mid. Nat. 1:226, 1910, quoted by Weatherby, Rhodora 21:174, 1919) that Thelypteris Schmidel, published in 1762 with three or four pages of description and comment and two very excellent plates, is the earliest valid name for the genus. It becomes necessary, therefore, to transfer two of our species that have not, so far as I can learn, been properly named.

Thelypteris normalis (C. Chr.) new comb.

Dryopteris normalis C. Chr. This is the plant heretofore referred to *D. patens* (Swz.) ktze.

Thelypteris arguta (Kaulf.) new comb.

Dryopteris arguta (Kaulf.) Watt.

Aspidium argutum Kaulf.

BIOLOGICAL SECTION.

The following lectures were held during the year in the lecture room of the Los Angeles Public Library: -

February 26, 1920.

Lecture by Dr. F. C. Clark, Subject, "The Evolution of the Elephant and its Relatives." Dr. Clark illustrated his interesting lecture by wood carvings of elephants and their related forms which were prepared by himself.

March 25, 1920.

Lecture by J. O. Beebe. Subject, "The Evolution of Dinosaurs to odd toed and even toed Ungulata (hoofed animals) including horses, camels, cattle, deer, swine, etc." This lecture was illustrated by a splendid array of plaster casts prepared by Mr. Beebe. The lecture was followed by an animated discussion by many of those present.

April 29, 1920.

Lecture was given by Dr. John Comstock, of the South Western Museum, on the "Aboriginal Man of North America." This lecture was most interesting and greatly appreciated by the large audience present. In the discussion which followed, the many questions answered by Dr. Comstock proved him to be a complete master of the subject. The lecture was illustrated by textile fabrics, weapons, and utensils loaned for the occasion by the Southwestern Museum.

May 27, 1920.

Lecture was given by Dr. R. W. Bowling on "The Human Cerebre-Spinal Axis in its relation to conduct." Dr. Bowling illustrated this lecture by casts of sections of the human brain and a relief plan of the spinal column showing in detail the various nerve off-shoots.

Dr. Bowling treated this subject anatomically, in a masterly manner, and in his ethical deductions he revealed a largeness of tolerance and charity toward erring human nature that was most appealing. The audience evidenced their approval of the lecture in the applause which greeted him at its close.

June 24, 1920.

Lecture was given by Dr. F. C. Clark, subject being "The Evolution of Birds from Jurassic Time to the Present." This lecture was illustrated with many bird specimens from the South Sea Islands and the eastern South American coast which added great interest to the meeting as well as serving to elucidate points of the lecture very forcibly. Models of other birds, both actual and hypothetical, in wood carvings, prepared by Dr. Clark, were used in his illustrations as well as the skeletons of birds. Mr. Keese, Treasurer of the Southern California Academy of Science, announced, amid much applause, that Dr. Clark had that day been elected President of the Academy for the ensuing year. Announcement was made that no meetings of the Biological Section would be held during July and August and that due notice would be given of the September meeting.

H. AITKEN, Secretary.

Lieut. Thomas L. O'Brien.

LIEUT. THOMAS L. O'BRIEN, member of the Board of Directors of this Academy, died May 28th at the Crocker Street Hospital in Los Angeles, after an illness of several months. Lieutenant O'Brien, at the beginning of our hostilities in the world war, was among the first to volunteer his services. Although past the usual age of enlistment (and conscription had not yet started) his fine physical condition and general fitness secured him in July, 1917, an appointment as private in the One Hundred and Seventeenth Regi-

ment of Engineers. After a short period of training at Camp Lewis, he went to the front with the famous Rainbow Division. So great was the need of reenforcement on the battle line to sustain the morale of the sore-pressed and over-wrought veterans there engaged that the Rainbow Division was sent almost immediately into the trenches. History has already recorded how well the division bore itself, and how, on several occasions when the need was sore, the engineers themselves took arms and engaged in the thick of the fray. Probably the danger was no greater in fighting, however or perhaps not so great, as in their regular line of duty in exploring no-man's land, and other hazardous undertakings which fall to the lot of the engineers. With his comrades O'Brien had six months of the strenuous life at the front, in which he bore himself so gallantly that he was first promoted to Sargent, and afterwards to Lieutenant.

After the allotted period of this strenuous activity, the regiment was sent back to join the reserves, and Lieutenant O'Brien rendered good service in connection with the commisary department in Paris. Later, by way of reward for his dangerous and faithful work, he was given a furlough to visit some of the principal cities in France, and later he entered the A. E. F. university at Baume. At the institute of Agronomy he received special recognition, in that his graduation papers, out of those of 130 American students, were translated into French and read at the public closing exercises.

Lieutenant O'Brien was born near Alma, Michigan, April 29th, 1870. After working his way through the Alma High School, he took up the occupation of teaching. He taught successively in the Brady school, the Prat school of Claire county, and the Grammar school. Later he secured a position with a publishing house, and earned sufficient money to pay his way through Albion College. After graduation he became principal of the Michigan State School for the Blind. In 1893 he took a course in the law college of Michigan University at Ann Arbor.

After graduation he removed to Milwaukee, where, in 1896, he married Miss Dana Squires, a union which proved most happy to the end of his life.

In 1902 Mr. and Mrs. O'Brien took up their residence in Los Angeles. His first business here was in the insurance and real estate line. He later became interested in public affairs, and was elected to serve with the famous reform Council of 1910-11. He served on the not less famous county grand jury of 1912.

Mr. O'Brien took a deep interest in civic and social matters. He was one of the organizers, and secretary and main-stay of the Proximo Club for several years, and was afterwards elected President and then President Emeritus of the club. He was also President of the Michigan Society.

IN MEMORIAM

Thomas L. O'Brien.

What freak of Fate to send our soldier back,
Safe from war's hazards and its fierce alarms!
What freak to follow in our soldier's track,
And snatch him after from our very arms!

Ah, but this game is hard to understand—
This hide-and-seek with Death, the elfish shade—
For when we seek we find him not at hand,
And when he seeks we may not then evade.

At duty's earliest call he answered "Aye,"
And when the need was greatest he was there;
Fighting that human freedom should not die,
Daring the storm as only freemen dare.

Steady he held his course through shot and shell,
Over the top and through the tangled wire,
Meeting the gas of hate, the flames of hell,
That hissed and roared the deadly German ire.

In every need he grandly bore his part,
To duty where he found it reconciled;
In camp and hospital a woman's heart,
And ways as gentle as a little child.

Oh, the sublimity of such a life!
Not less the hero for his virtues all.
Stern and undaunted on the field of strife,
Yet ready aye to answer Mercy's call.

And through ten thousand dangers unafraid
Comes back our soldier to his happy home,
Seeking the peace his noble deeds have made,
Seeking the rest and comfort that should come.

Ah, but this scheme is hard to understand.
The hand that throws the shuttle over, under,
Weaving our lives together strand on strand,
Then rudely tears the woven web asunder.

But what the Weaver's purpose who shall tell?
Perchance a better pattern He would gain.
Register joy, for He hath woven well;*
Register joy, our hero's free from pain.

WILLIAM A. SPALDING.

*Note. A message to his wife and by her transmitted to the Proximo Club—his last word to fellow members: "Register joy, for I am free from pain."

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BULLETIN OF THE
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The Immigrant Plants of Southern California

S. B. PARISH

The distinction between the indigenous and the immigrant constituents of our present flora is merely in the time and manner of their accession thereto. All are of foreign ancestry, even the endemics, which are either lingering relics, or modified mutants, of former invaders. Once and again cosmic oscillations of climate have driven out the old inhabitants, and in time opened the way for new races. In historic times additions have been made by the agency of migratory birds, or by the currents of the ocean or of great rivers.

All these elements we are content to call indigenous, and, by a narrower definition, to restrict the term immigrant to those whose presence is due, directly or indirectly, to human agency. So far as California is concerned, this agency may be confined to civilized man, for the Indians of the Pacific coast were without agriculture or commerce, and depended for their subsistence on the natural products of land and water. In their limited wanderings they may have disseminated to some extent the seeds of the native food plants; but only in such slight degree did they disturb the operation of natural processes.

It will be safe, then, to assume a very definite date for the beginning of that foreign invasion which since has so greatly modified the plant population of the State. For it must have been a virgin flora that greeted the eyes of Fr. Serra and his companions, when, on the 14th day of May, 1769, they reached the bay of San Diego, to begin the conquest of California Alta for Holy Church and the Spanish Crown. The few previous explorers had arrived by sea, and had made but transient landings, but the followers of Saint Francis brought with them flocks and herds, and in the careful preparations for their expedition they had been particularly charged to provide themselves with store of seeds of useful plants. Step by step the long chain of missions was stretched northward along the coast, until, in 1823, the last was founded, in honor of San Francisco de Solano, near the site of the present town of Sonoma. Everywhere one of the first proceedings was the planting of gardens, and the sowing of fields; and the neophytes, as they were gathered in, were taught to be farmers and herdsmen, so that each mission speedily became a hive of industry, based on its wide acres and countless herds. Eventually a considerable secular immigration came from Mexico by way of Lower California and of Sonora, the last passing through the present Arizona and the Colorado Desert; and a scanty commerce, licit and illicit, visited the ports.

THE MISSION PERIOD

It was during this pastoral period that, in the pellage of domestic animals, and in the seed for sowing, those Mediterranean plants, the wild oats, the bur clover, the filaree, the wild mustard, and others, were introduced, which today form so distinctive a feature in our flora. Their advance over the coast was from south to north, as each new mission drew its stock of seeds and animals from the granaries and herds of the older ones. Most of these introductions were distinctly beneficial, greatly augmenting the forage resources of the country; few of them have proved seriously harmful.

These conclusions are only matters of reasonable inference, for in their writings the good fathers make but vague and scanty reference to the vegetation about them. They were without the least tincture of botanical knowledge, and noted the aspect of forest or meadow solely from the economic point of view. Their most frequent observations relate to the possibilities for grazing, and were usually confined to noting that they found a place "con pasto" or "sin pasto," as grass was plentiful or wanting. Fr. Crespi,[1] the diarist of Portola's expedition, and of them all the most appreciative of natural beauty, had some eye for the bright flowers that enlivened the landscape; but most of all was his heart drawn to the "rosa de Castilla" by the brookside, or to some aromatic herb[2] which recalled the "romero" of his native hills in far-distant Spain.

The later years of this period were signalized by the visits of some famous early botanists. In 1831, David Douglas, in the course of his extensive travels on the Pacific coast, made collections at Santa Barbara; in the next year Thomas Coulter journeyed from Monterey to the Colorado river; in 1835 Thomas Nuttall spent some time at Santa Barbara and San Diego. Their labors added greatly to the knowledge of the indigenous flora; but they either found few alien plants, or they disregarded them. Just before the mission period drew to its close, John C. Fremont, in 1845, in the course of his adventurous second expedition, rode from north to south through the great valleys, and across the mountains and deserts of the future state. His journal records many interesting observations concerning the vegetation along his route, but he notices but one introduced plant.

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[1]Crespi. Juan Viage de la espedicion de tierra de San Diego a Monterey. 1769.

[2]Probably **Trichostema lanceolatum** Benth., which is still so called by Spanish-speaking Californians.

THE PIONEER PERIOD

The bucolic period of Californian history was rudely brought to an end by the inrush of gold-seekers from all quarters of the globe, following the discovery of the precious metal in 1848. Whether they arrived by water or by the overland trails, they must have brought in their belongings the seeds of new weeds, which were further added to by the sudden commerce which sprang up to supply their needs. In these ways many cosmopolitan weeds must have made their appearance at the port of San Francisco, and in the mining camps. The southern counties attracted little of this new population, for here the mines were few and unimportant, and so they were not much affected by the accompanying invasion of alien plants. Some of these speedily worked their way down the coast, thus reversing the direction of the migrations of the mission period. This process of extension is still uncompleted.

For this period we have a considerable body of botanical literature. No prospector, it is true, turned from the mad rush for wealth to regard the plants he uprooted in his search; but there were not wanting a few to whom knowledge was more precious than gold. Dr. Albert Kellogg, the first resident Californian botanist, arrived at Sacramento in 1849, and in 1850 Dr. H. H. Behr landed at San Francisco. These two physicians became lifelong residents of the State, and their interest in science early divided their attention with their professional practice, and led them to record the results of their studies in different journals. This, too, was the time of many explorations and surveys undertaken by the general government, which always included collections and observations on botany, duly recorded in the published reports. While these various publications are a mine of wealth so far as they relate to the indigenous plants, they are disappointing when searched for information concerning the weed flora. They record few immigrant plants, except the most abundant of the mission introductions, already broadspread over the land. Were one to judge from this negative evidence the number of introduced plants must have been very small at that time. But it is probable that these botanists, like most collectors in new fields, gave their attention mainly to the many unfamiliar plants, whose novelty attracted them, to the neglect of the common weeds they knew so well at home.

THE RAILWAY PERIOD

Of all the means by which weeds are disseminated railways easily rank the first. The freight car carries its unbroken load from one end of the country to the other; animals, grain, and goods of all kinds, instead of the limited movement otherwise possible, are transported by rail wherever the market demands, regardless of distance. Population is increased, agriculture and commerce are stimulated, resulting in a constantly augmenting traffic. Frequently the introduction of a new weed can be directly traced to railway transportation, and its progress can be followed by records of its appearance about railroad tracks or yards. Such is the case with several now widely distributed weeds.

For this period we enjoy definite records, beginning with Brewer & Watson's Botany of the Geological Survey (1876, 1880), down to the present day. Several Floras have been published, covering different parts of the State, and many papers have appeared in the botanical journals, so that there is now a considerable knowledge of the composition of our flora. Information concerning immigrant plans is embodied in these sources, and a few papers relate entirely to them. A list of such papers will be found on a subsequent page.

GEOGRAPHIC AND CLIMATIC LIMITS

The area which this paper seeks to cover is that part of the State of California south of Santa Barbara on the coast and Tehachipi Pass in the interior. But while these limits have been observed as to the plants to be included, it has been thought allowable to adopt a wider horizon in the treatment of some of them.

The physical configuration of this region, and its great climatic differences, exert a determining influence not only on the indigenous flora, but on the exotic as well. These restrictive conditions operate less rigorously on the introduced weeds than on the native plants, enabling the foreigner, favored by the operations of agriculture, to occupy places from which undisturbed natural conditions would exclude it. It is for this reason that most immigrant plants are restricted to the precincts of cultivation, only a few being able to overpass these limits.

The great climatic areas into which Southern California is divided are three: the desert, the mountain, and the region between the Sierra and the sea, usually called the cismontane.

THE DESERT

The desert area, larger than the two others combined, is a land of parching heat, violent winds and scanty and irregular rainfall. The soil in many parts is of excellent character, but deficiency of water confines vegetation to such specialized plants as possess an adaptation to this rigorous environment. Up to a recent time there was no cultivation, except at a few small oases, and it was only there, and as a scanty and transient growth about mines and camping places, that foreign plants could be found. Recent years have seen a change: towns, some of them of considerable size, have sprung up along the railways which traverse the deserts, and in every place where, by any means, water can be obtained for irrigation, lands of greater or less extent have been brought under the plow.

The largest of these tracts is Imperial Valley, a body of rich alluvial soil situated in the southwestern part of the Colorado Desert, beneath the level of the sea. In 1902 water from the Colorado River was carried on to these lands sufficient to irrigate 300,000 acres, and these are now under intensive cultivation. In 1912-1913 a survey of the flora of this valley showed that the majority of the weeds common in the older settlements, had not yet arrived, and that most of those which had made their appearance were, as yet, infrequent. It is probable, however, that an investigation made at the present time would show a great increase in the number and abundance of exotic weeds. Two other facts in relation to the weed flora were brought out by this survey; namely, that not an immigrant plant was found on the open desert beyond the limit of irrigation; and that the weeds most troublesome to the farmer were plants indigenous in the overflowed lands of the delta, carried by the irrigation system onto the fields, where they flourished with great luxuriance. Elsewhere in the deserts, where local wells are the source of irrigating water, the surrounding native plants are not likely to be attracted by cultivation; but in time the farmer will have to contend with many of the common pests of agriculture, while the feral hills and plains will remain largely immune from their invasion.

THE MOUNTAINS

The mountain area is the least extensive of the three under which our region is considered. It is exceedingly rugged, its ascents abrupt, and in places precipitous; several of the summits exceed 10,000 feet in altitude, and the loftiest attains 11,725 feet. Above 5,000 feet they are mostly covered with an open forest of pines and other conifers. Neither the soil, nor, in the higher parts, the climate, is favorable to cultivation, but below the 4,000 feet contour there are limited tracts where it succeeds. Consequently the immigrant flora is scanty, both in species and in individuals. Some increase is to be expected, since good automobile roads now render access easy to many parts of the mountains, drawing thousands to them for their summer vacations.

THE CISMONTANE REGION

The cismontane is a region of fertile soils, where an extensive and varied agriculture is carried on, mostly by irrigation. It is filled with cities and towns, with their accompanying industries; and in all parts it is well served by railways, three of them transcontinental. It was also the earliest settled part of the State, and the site of the first missions and of the earliest pueblos.

These conditions naturally result in the presence of an abundance and diversity of introduced plants. They may be considered in two groups, which are determined by their growth-requirements. The first includes plants whose long period of growth needs a continuous seasonal supply of water, and to which, in most cases, a rich soil is essential. These requisites are to be found in the farms, the orchards, the gardens and lawns, and other cultivated and irrigated lands, or in the infrequent small tracts naturally moist. Here grow the common weeds of cultivation, with a few of more restricted range; and here are now appearing other cosmopolitans, often as yet mere casuals. To this group belong the deep-rooted annuals, and all the perennials save one.

Most plants belonging in the second group, while found in cultivated grounds, are also able to contend with the native plants of the feral mesas and hills. To do so they must share the life adaptations of the indigenous vegetation with which they are brought into competition. This consists mostly of annual herbs, which complete their cycle of existence during the few rainy months, or of perennials, mostly shrubby or suffruticose, able, by reason of special adaptations, to survive the long dry season. A single introduced perennial, horehound, is of this class; the others are quick-growing annuals, mostly grasses. Here belong a number of Mediterranean plants, dating from the mission era, now widely spread over the state, and a few pestiferous bromes, recently introduced, but disseminating themselves with great rapidity. The number of species is not great, but in individuals, and in the extent of ground which these weeds occupy, and often monopolize, they exceed all the others combined, and little or nothing can be done to combat them. The early immigrants possessed qualities which made them a valuable addition to the plant population, but the later-comers are entirely worthless; but good and bad alike have greatly modified the native vegetation, and in places replaced it. In very many they are the prominent feature of the plant covering, and impart to the landscape a foreign aspect. It may well be that in no long time extensive bodies of an unmixed native flora will be found only on the arid deserts or the higher mountains.

BEHAVIOR OF THE IMMIGRANT FLORA

The intrusion of man has thus disturbed the equilibrium attained by the long interaction of natural causes. Not only have his various activities been directly or indirectly destructive to the native vegetation, but he has introduced new, and often vigorous, competitors in the struggle for existence. Were he now to withdraw, the forces of nature, again free from his interference, would tend to the restoration of former conditions. In time new forests would replace those the woodman has felled, and the old chaparral would repossess the cleared hills. These tracts have been practically unaffected by the introduced vegetation; but not so the open mesas and slopes and the naturally damp meadows. Here, in the farms,

the gardens and the orchards, flourish the cosmopolitan weeds which constitute so large a part of the foreign plant population. These depend upon the advantages they enjoy from cultivation and irrigation, and without them would disappear; a result which may be seen in abandoned fields. But the other immigrants which are able to dispense with these aids, and to compete successfully with the natives under the unmodified conditions of nature, have won from them much of the land. It can hardly be thought that the bunch-grasses and the delicate herbs which once occupied it could ever reclaim it from the wild-oats and the aggressive bromes now in possession. It would, indeed, remain grass-land, but the primal species could never regain their dominance.

It may be of interest to note the conduct of these immigrants in their new homes. Some advance slowly, step by step, but persistently; others, once introduced, spread with the rapidity of an epidemic; a few having attained a limited local foothold, do not overpass its bounds. These differences are not entirely dependent upon varying facilities for dissemination, important as these are. The effect on distribution of the more strongly marked climates has been already considered; but the aliens share with the natives in their subjection to minor climatic and edaphic variations. Some plants of either class abound under the cooler and damper conditions near the seacoast, and one by one disappear as the aridity increases towards the interior. Not always are the limiting causes easily recognized, but it is evident that the plant which demands the least delicate adjustment to environment has the best chance for wide diffusion. Yet it cannot be predicted, from the character borne by a weed elsewhere, what future may await its introduction here. Some which have overrun the Atlantic states have here proven failures. The wild carrot has more than once obtained a foothold, but has not retained it; forty years ago I knew **Datura Tatula** as an infrequent weed in my neighborhood, and infrequent it still remains.

EXPLANATIONS

Plants in economic or ornamental cultivation and rarely found as temporary escapes, are not included in the following catalogue; nor are those indigenous plants which are among our common weeds of cultivation. General statements as to distribution apply only to the cismontane region, occurrence in the deserts or mountains being specially noted. Stations are reported, except for the commoner species, and as far as possible chronological data are supplied; in these notes the writer's name as authority is omitted, unless ambiguity might ensue. Notes on distribution in other parts of the state are based on an examination of specimens in the herbarium of the State University, and on published records. The bibliography includes all the papers or notices I have been able to find which relate exclusively to the weed flora of the state. In conclusion, I desire gratefully to acknowledge the assistance I have received, in relation to the plants of their respective regions by notes and specimens kindly communicated by Dr. A. Davidson, of Los Angeles, Mr. I. M. Johnston, of Upland, and Mr. F. M. Reed, of Riverside.

SUMMARY

The number of species and varieties enumerated in the subjoined catalogue is 281; they may be segregated as follows: Naturalized and generally distributed 76, naturalized but common only in certain localities 55, naturalized, but nowhere abundant 55, adventives, fugitives and waifs 95. The genera are 177; Bromus has 12 species, no other as many as ten. There are 41 families; the Gramineae, with 69 species or varieties, the Compositae, with 49, the Cruciferae, with 21, the Leguminosae, with 16, the Polygonaceae, with 13, and the Caryophyllaceae and Solanaceae, with 11 each, are the only Families having as many as ten.

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SYSTEMATIC CATALOGUE

NAJADACEAE

Potamogeton crispus L.
Abundant in the Santa Ana River near Corona, **Johnston** in 1918. Not otherwise known from the state. Native of Europe.

ALISMACEAE

Sagittaria latifolia Wild.
Increasingly frequent on the marshy borders of small streams. San Bernardino; appeared first in 1890. Los Angeles, **Braunton** in 1902. Regarded as native in the tule marshes of central California, but in the south introduced through use by Chinese, who eat the tubers.

GRAMINEAE

Holcus halepensis L. Johnson Grass. Means Grass.
Introduced into California about 1884 as a valuable forage grass, and for a few years cultivated to a limited extent, but found undesirable; soon escaping, and now a frequent and troublesome weed in orchards, farms, and other irrigated lands, and in waste places. In the Colorado Desert, a single clump, at El Centro, **Parish** in 1913. First introduced into the United States in 1830, by a cotton expert, who was sent to Turkey by Governor Means, of South Carolina, and who brought

back, on his return, seeds of a number of supposedly valuable plants, including this grass.[4] An annual variety, known as Sudan Grass, has recently come into cultivation, and is beginning to escape. Upland, **Johnston** in 1918. Native of Asia and Africa.

Paspalum Larranagae Asch.

Palm Springs Station, Colorado Desert, in ground irrigated by the railway water tank, **Parish** in 1913. Otherwise known in the state from a single station in Butte County. Native of Mexico.

Digitaria humifusa Pers.

Pasadena, recently introduced, **Grant** in 1906; Foster, San Diego County, **W. D. White** in 1916. Native of Europe.

Digitaria sanguinalis Scop. Crab-grass.

A common and long-established weed in cultivated grounds, as abundant thirty-five years ago as now. Native of Europe.

Panicum capillare L. var. **occidentale** Rydb. **P. barbipulvinatum** Nash.

Entirely confined to cultivated and waste grounds, where abundant and long-established, and appearing in every way like an introduced weed, but considered by Hitchcock[5] to be native. The species itself probably occurs, but data are wanting.

Panicum miliaceum L. Broom-corn Millet.

An occasional waif. Riverside, **Reed** in 1910, 1918. Upland, **Johnston** in 1917. Native of Europe.

Echinochloa colona Link. Jungle Rice.

An abundant weed in the cultivated parts of the Salton Sink, Colorado Desert, **Parish** in 1913; introduced by irrigating water from the bottom lands of the Colorado River, where it is common. Occasional in the Cismontane. Orange, **Mrs. Bradshaw.** Riverside, **Reed** in 1918. Upland, troublesome in gardens, **Johnston** in 1918. The most northern specimen seen is Visalia, **Congdon** in 1881. Native of Europe.

Echinochloa crus-galli Beauv. Barnyard Grass.

Naturalized in rich, damp soils of cultivated and waste grounds, and along ditches. Long established; at San Bernardino as abundant in 1880 as at present. Throughout the state. Native of Europe.

Echinochloa zelayensis Schult.

Common in the Colorado River bottom lands (Yuma, in 1912), thence water-borne to the Salton Sink, where it abounds on river banks, and along ditches. Native of Mexico.

Setaria geniculata Beauv. S. gracilis H BK.

A recently introduced, and increasingly frequent roadside grass in damp soils. Los Angeles, **Hasse** in 1892, and **Greata** in 1900. Riverside, **Parish** in 1897, San Bernardino in 1907, and Santa Barbara in 1916. Fresno, **Griffiths,** is the most northern station reported. Native from Florida to Mexico.

Setaria lutescens Hubbard. S. glauca Beauv. Yellow Foxtail.

Recently naturalized, and now frequent along roads and in fields; probably introduced in foul seed grain. Rialto, **Parish** in 1890, and San Bernardino in 1895. Riverside, Reed in 1904. Claremont and Pomona, **Johnston,** in 1918. Apparently introduced earlier in central California, as Hilgard[6] reported it in 1890 as already "a terrible pest in alfalfa fields." Native of Europe.

Setaria verticillata L. Bristly Foxtail.

Roadside at Upland, **Johnston** in 1918, the only Californian collection. Native of Europe.

Setaria viridis Beauv. Green Foxtail.

A recently introduced, and still infrequent, roadside grass. San Bernardino, in 1916. Native of Europe.

Leersia oryzoides. Swartz. Rice Cutgrass.

Locally established at a road crossing of Mill Creek, San Bernardino, in 1885; now abundant for some two miles along the borders of this stream, and of Warm Creek, into which it empties. The only other known station in the state is in Lake County, **Bolander,** before 1860. Native of the western states.

Pennisetum villosum R. Br.

A local fugitive from ornamental cultivation. Santa Barbara, **Eastwood** in 1908, and **Parish** in 1916. Ventura, **Parish** in 1916. Native of Abyssinia.

Cenchrus panciflorus Benth. Bur grass.

An increasing, but not yet frequent, pest in pastures and by roadsides, in damp soils. Near Colton, **Parish** in 1890, and **Rialto** in 1913. Redlands, **Greata** in 1906. Riverside, **Reed** in 1906, and "troublesome in orchards" in 1918. In the Colorado

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[4]Ball, C. R., U. S. Dept. Agric. Bur. Pl. Ind. Bull. 11:7. 1902.
[5]Hitchcock, A. S., in Jepson, Fl. Cal. 91. 1912.
[6]Hilgard, W. E. Weeds of California 47. 1891.

Desert at Mecca, a depauperate form less than inch high, on overflowed land, **Parish** in 1913. Occasional throughout the state; said to be one of the two worst weeds about Bakersfield.[7] Native of the Atlantic coast.

Phalaris canariensis L. Canary-seed Grass.

An occasional waif. Pasadena, **Grant.** San Clemente Island, **Lyon** in 1895. Santa Catalina Island, **T. S. Brandegee** in 1916. Native of Europe.

Phalaris caroliniana Walt.

Infrequent. Palms, Los Angeles County, **Grant in 1901.**. San Diego, **T. S. Brandegee in 1903.**. Ojai, **Hubby.** Native of the southeastern states.

Phalaris minor Retz.

Somewhat widely naturalized. San Bernardino, **Parish** in 1882, and Playa del Rey in 1918. San Diego, **Orcutt.** Railway embankment, El Monte, **Johnston** in 1917, and in orchards in the Claremont region in 1918. La Jolla, **Clements** in 1914. Native of the Mediterranean region.

Phalaris paradoxa L. var **praemorsa** Coss. & Dur.

San Diego, **T. S. Brandegee** in 1902. La Brea Ranch, **Davidson** in 1916. Native of Europe.

Anthoxanthum odoratum L. Sweet Vernal Grass.

Occasional in lawns at Los Angeles, **Davidson** in 1895. Native of Europe.

Oryzopsis miliacea Benth. & Hook. Smilo Grass. San Diego Grass.

Roadside near Los Angeles, **McClatchie** in 1896. Abundant in the streets of Santa Barbara, **Parish** in 1916, 1918. Monrovia, **W. W. Phillipson** in 1916. Ventura, **Essig** in 1918. Said to be cultivated in San Diego County as a dry land crop. Native of Europe.

Phleum pratense L. Timothy.

An infrequent waif. Riverside, **Reed** in 1917. Santa Monica, **Parish in** 1918. Claremont, **Johnston** in 1918. Victorville, Mojave Desert, **Palmer** in 1888.[8] Not grown, nor the hay imported, in our region. Frequent in northern California. The name Timothy is said to come from one Timothy Hanson, who introduced the grass into Maryland in 1720.[9] A native of Europe.

Polypogon littoralis Smith.

Common in wet soils, notably along ditches and shallow streams. North to Vancouver Island. Native of Europe.

Polypogon monspeliensis Desf.

An abundant vernal grass in cultivated and waste, and frequent in unbroken grounds. Occasional throughout the deserts; Imperial Junction, **MacDougal** in 1912; Mecca, **Parish** in 1913; Furnace Creek, **Coville & Funston** in 1891. Antelope Valley, **Davy** in 1893. Surprise Canyon, **Hall & Chandler** in 1908. Postoffice Spring, **Parish** in 1915. Common throughout the state. Native of Europe.

Agrostis alba L. Redtop.

Occasional in meadows and by roadsides in damp soil. San Bernardino, **Parish** in 1892. Los Angeles, **Davidson** in 1918, and Big Rock Creek in 1901. San Antonio Mountains, at 5,000 ft, alt., **Johnston** in 1917. Cultivated in some parts of northern California, and naturalized; but not in the south. Native of Europe.

Agrostis stolonifera L.

Common in damp soils, in cultivated and waste grounds, reaching 6,000 ft. alt. in the San Bernardino Mts. Bear Valley, **Parish** in 1882. North to Mendocino County. Native of Europe.

Gastridium lendigerum Gaud.

Common on dry plains and hillsides near the coast, extending inland to Claremont and Ontario. A few plants at San Bernardino in 1907 are the most inland reported. North to Humboldt County. Native of southern Europe.

Ginannia lanata Hubbard. **Notholcus lanatus** Nash. Velvet Grass.

Infrequent, and probably only as a waif. Pasadena, **McClatchie** in 1894. San Jacinto, **Davidson** in 1895. Cuyamaca Mts., **T. S. Brandegee** in 1894. Frequent from Monterey northward. Native of Europe.

Aira caryophylea L. Hair Grass.

A waif at San Bernardino in 1894. Common in northern California. Native of Europe.

Avena barbata Brot. Slender Wild Oats.

Widely distributed, usually less abundant than the next species, but near the coast in San Diego County often covering wide areas with a dense pure stand, 4 to 5 ft. high. First reported from California in 1885,[10] but with little doubt an early introduction.

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[7]Monthly Rept. State Comm. Hort. 6:437. 1917.
[8]Vasey & Rose, Cont. U. S. Nat. Herb. 1:8. 1890.
[9]Vasey. G. Descr. Cat. Grasses U. S. 42. 1885.
[10]Vasey G. Descr. Cat. Grasses U. S. 56. 1885.

Avena fatua L. Wild Oats.

Abundant throughout the state, except in the deserts and mountains. In the Colorado Desert, infrequent at Brawley, in 1913.

Avena fatua L. var. **glabrescens** Peterm.

Probably as widely distributed as the species, but less abundant, and not distinguishable from it by gross aspect.

The wild oats must have been among the earliest introductions of the mission era, and being well suited to the conditions, have spread with rapidity. Newberry[11] says that in 1855, throughout central and southern California, wherever the ground was not occupied by forests, wild oats "covered surfaces of many hundreds of miles in extent as completely as the grasses cover the prairies of Illinois," and he was inclined to regard them as indigenous. This report indicates that at this early date they were even more abundant than at present, the increase of cultivation having curtailed their area. They are frequent in cultivated grounds, especially as "volunteers" in grain fields, but they also occupy great tracts of hills and plains. They afford good pasturage, and in early years were extensively reaped for hay. It is by way of California, doubtless, that the wild oat has reached other parts of the United States. All are natives of the Mediterranean region, but entered this state from Mexico. In recent years the tame oat is much grown here, and is a frequent temporary escape.

Cynodon Dactylon Pers. Bermuda Grass.

Abundantly naturalized in irrigated or damp soils, both cultivated and unbroken, and often persisting in dryer places. A most obnoxious weed in orchards, vineyards and gardens; very destructive to alfalfa fields, where it chokes out and supplants the crop, rendering it necessary to replant frequently, and in the same way destroying lawns. The seeds are carried by the irrigating water, so that it is practically impossible to prevent its entrance into irrigated lands. In the Colorado Desert it was frequent in fields and about houses in 1913.

Although now so abundant it probably was not a very early introduction, at least in the south. At San Bernardino it was still rare about 1880, and I have found no early record of its presence in the state. Often, but wrongly called "Devil Grass," properly the name of **Paspalum distichum** L. Native of the warmer parts of the Old World.

Chloris elegans HBK.

Common in the bottom lands of the Colorado River, since before 1860;[12] thence water-borne to the Salton Sink, where it is abundant in fields and about habitations. Near Mecca, a reduced form, less than inch high, in flooded ground in the open desert, **Parish** in 1913. Greenland Ranch, Death Valley, **Coville & Funston** in 1891, but not found there by me in 1915. An occasional waif in the cismontane region. Riverside, **Reed** in 1904. Pomona, **Mrs. H. S. Yates** in 1914. Claremont, in alfalfa fields, **Johnston** in 1918. Native of Mexico.

Eleusine indica Gaertn. Goose Grass.

Sparingly introduced in lawns, supposedly in clover seed, Los Angeles, **Davidson** in 1907. Native of the Old World.

Arundo donax L. Reed.

Occasional, and sometimes locally abundant, along the banks of streams. Los Angeles River, **Lyon** in 1889. Santa Ana River, near Redlands, **Parish** in 1894. San Gabriel River, **Johnston** in 1918. Occasional in ornamental cultivation, from which an escape. Probably first brought into the state during the mission period. An aged Mexican informed Mr. Lyon that as early as 1820 it was so plentiful along the Los Angeles River that it was gathered for roofing material, for which it was preferred to the "tules" commonly used for that purpose. Native or Europe.

Eragrostis mexicana Link.

An infrequent weed by roadsides and along ditches. Santa Ana, **Parish** in 1882, and Redlands in 1892. San Diego, **Orcutt** in 1885. Native of Mexico.

Dactylis glomerata L. Orchard Grass.

An infrequent and short-lived wayside waif. San Bernardino about 1886. Claremont and Pomona, **Johnston** in 1918. Frequent in parts of northern California. Not cultivated in the south. Native of Europe.

Cynosurus cristatus L. Dog's-tooth Grass.

Rare in lawns, Los Angeles, **Davidson.** Native of Europe.

Lamarkia aurea Moench. Golden-top Grass.

First collected in the United States by **Parry & Lemmon** in 1875, a few plants only, at the mouth of Mill Creek, San Bernardino Mts., but probably already established about Los Angeles, where found in great abundance by **Parry** in 1881, although at that date it was still very rare about San Bernardino. Now abundant in spring in dry soils throughout southern California. Also common in central California, where the earliest record is Edendale, Santa Clara Valley, **Davy** in 1893. Native of the Mediterranean region.

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[11]Newberry J. S. Pac. R. R. Survey, 6 pt. 3:13. 1857.

[12]Thurber. G. Pac. R. Rept. 5, pt. 4:30. 1860.

Poa annua L.

Frequent by roadsides and in waste places in damp soil. Also quite frequent in the mountains at about 6,000 ft. alt. Cuyamaca Mts., **T. S. Brandegee** in 1893. Big Meadows, San Bernardino Mts., **Hall** in 1906, and San Antonio Mts. in 1900. In the Mojave Desert, in the Panamint Mts., **Hall & Chandler** in 1906, and Granite Wells, **Parish** in 1915. Native of Europe.

Poa compressa L. Canada Bluegrass.

Infrequent in the streets of Los Angeles, **Davidson** in 1918. Native of Europe.

Poa pratensis L. Kentucky Bluegrass.

A favorite lawn-grass, thence a fugitive to waysides. Also frequent in mountain meadows, at 6,000-7,000 ft. alt., where it has been considered indigenous, and so appears. Native of Eurasia and North America.

Festuca bromoides L.

Frequent in unbroken and cultivated grounds. Native of Europe.

Festuca elatior L. Meadow Fescue.

An infrequent waif. Oak Knoll, Pasadena, **McClatchie** in 1895. Los Angeles and Santa Monica, **Davidson** in 1892. More abundant in northern California. Native of Europe.

Festuca Myuros L. Rat-tail Grass.

A very abundant spring grass in unbroken and in cultivated sandy soils. San Bernardino, abundant in 1882. Santa Catalina Island, **T. S. Brandegee** in 1890. Probably an early introduction. The earliest record is from Monterey, **Brewer** in 1861. Native of Europe. **F. megaleura Nutt,** grows with the above species, and is quite as abundant, and not readily distinguished from it, but is considered indigenous.

Bromus arenarius Labill.

First collected, a few plants only, by the roadside in Waterman Canyon, San Bernardino, **Parish & Reed** in 1905, but probably already introduced elsewhere; now much increased in that vicinity, and beginning to appear in other canyons of those mountains. Very abundant in grain lands at Red Hill, near Uplands, **Parish & Johnston** in 1917. In the Mojave Desert at the Shoestring Mine, Tejon Pass, in 1914, Waterman Ranch, near Barstow, and "The Cave," in a remote part of the Ivanpah Mts., all in 1915, and in each case only a few plants. North to Mariposa County. Not reported from beyond the state boundaries. Native of Australia.

Bromus commutatus Schrad.

An infrequent waif. San Bernardino, in 1891. Orange and Redlands, **Davy** in 1902. The earliest record is San Francisco, **Bolander** before 1880.[13] Native of Europe.

Bromus hordeaceus L. Soft Chess.

Increasingly frequent by roadsides and in meadows; probably of recent introduction. Santa Monica, **Hasse** in 1890. Los Angeles, "not common," **Davidson** in 1896. Common at Santa Ysabel and Oceanside, **Parish** in 1896. Ascends the San Bernardino Mts. to 3,500 ft. alt. In the Mojave Desert, in the railway park at Barstow, **Parish** in 1915. Earlier established in central California. Common by roadsides and in neglected fields, **Hilgard** in 1890. Napa Valley, **Jepson** in 1893. Ukiah, "the prevalent grass in some ranges," **Davy** in 1899. Native of Europe.

Bromus hordeaceus L. var. **leptostachys** Beck.

Abundant by a roadside, in marshy soil, San Bernardino, in 1916. Native of Europe.

Bromus madritensis L.

Locally abundant in hard, arid soil, Fort Tejon, **Parish** in 1887, the first reported collection in the United States. Santiago Peak, Orange County, **Abrams** in 1904. Infrequent north to Oregon. Native of Europe.

Bromus rubens L.

One of the most widely spread, abundant and thoroughly naturalized grasses of the cismontane region; of recent introduction, but with the greatest rapidity overspreading arid plains and hills, and cultivated grounds. San Bernardino, in small amount, in a stubble field in Reche Canyon, in 1886. Ascends the mountains to 3,000 ft. alt. In the Colorado Desert, at Palm Springs, in 1913. In the Mojave Desert, in waste places, at Mojave, Kramer and Leastalk, in 1915. The earliest record in the state is Plumas County, **Lemmon,** before 1880.[14] Native of Europe.

Bromus tectorum L. var. **nudus** Klett & Richter.

Infrequent in the south. Santa Barbara, **Agnes Chase** in 1910. Ontario, and Euclid Avenue, Upland, extending up San Antonio canyon to 5,000 ft. alt., **Johnston** in 1918. Apparently widely distributed at the north. Yosemite, **Bioletti** in 1900. Klamath River, **Chandler** in 1901. Sissons, **Davy** in 1902. Yreka, **Butler** in 1904. Native of Europe.

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[13]Thurber, G. in Brew. & Wats. Bot. Cal. 2:320. 1880; as **B. racemosus** L.
[14]Thurber, G. **Op. cit.** 2:319. 1880.

Bromus secalinus L. Cheat. Chess.

An infrequent waif, failing to become established, as seems to be its status throughout the state. Glendale and Los Angeles River, **Davidson** in 1893. Native of Eurasia.

Bromus scoparius L.

Santa Barbara, **Somes,** acc. to Hitchc. in Jepson, Fl. Cal. 173. Native of Europe.

Bromus sterilis L.

Matilija, Ventura County, **G. B. Macleal** in 1897. Not otherwise known from the state. Native of Europe.

Bromus unioloides HBK. Schrader's Brome-grass.

Common in cultivated fields, in gardens, about houses, and by roadsides. In like places in the Mojave Desert, at Barstow and in Panamint Valley, in 1915. Probably native of Mexico.

Bromus villosus Forsk. var. **Gussonei** Aschers. & Graebn. **B. maximus** Desf. Broncho Grass.

First found in San Bernardino, in small amount, in a stubble field, in Waterman Canon, in 1888. Orange, **Davy** in 1900. Los Angeles, "rare and local," **Davidson** in 1893. This grass spread with as great rapidity, and is now as abundant, as **B. rubens,** not only in the south, but throughout the state. It ascends the mountains more commonly, and to a greater altitude, than that species. Lytle Creek, San Antonio Mts., 5,750 ft. alt., Hall in 1900, and Cuyamaca Mts., 2,500 ft. alt., in 1899. In the Mojave Desert at Kramer, Barstow and Leastalk, **Parish** in 1915. The earliest collection in the state was in a cultivated field at Mission Dolores, San Francisco, about 1862. Other collections are: Lake Tahoe, **Lemmon** in 1889; Castroville, **Davy** in 1901; Napa, **Jepson** in 1892. Native of Europe.

This grass and **B. rubens** are, on the whole, the most obnoxious weeds in southern California. Being vernal in their growth, they are not as troublesome in cultivated grounds as in fallows and the dry soils of plains and hills, which they often occupy, to the exclusion of the native vegetation. As a result, some delicate indigenous herbs, formerly abundant, are now rare. The two species seldom grow together, the broncho grass usually monopolizing the better soils, while **B. rubens** can occupy the most arid hillsides, which it covers with a dense depauperate growth. Both species are sparingly eaten when young by stock, but are practically worthless as forage, and soon drying up they become a serious fire menace.[15]

Lolium perenne L. Rye-grass.

Naturalized and common by waysides and in meadows. Native of Europe.

Lolium perenne L. var. **italicum** Hook. **L. multiflorum** Lam. Italian Rye-grass.

An infrequent waif. Old San Bernardino in 1891. Ojai, **Hubby** in 1896. A variety of cultivation nowhere known as indigenous.

Lolium temulentum L. Poison Darnel.

Naturalized and common by waysides and in meadows. In the Mojave Desert, at Needles, **Jones** in 1901. The poisonous character of this grass is now ascertained to be due to the toxic properties of a fungus in the tissues under the seed coat, present only when the grass is thus diseased. Native of Europe.

Lolium temulentum L. var. **arvense** Bab.

Distribution the same as that of the species; in most places more abundant, and notably frequent in grain fields. Native of Europe.

Monerma cylindrica Cos. & Dur.

Occasional along the seacoast. Oceanside, on the borders of a pond and by the roadside, in subalkaline soil, **Parish** in 1897. Ballona, **Abrams** in 1901, and Mesmer in 1902. La Jolla, **Clements** in 1914. Colegrove, **Moxley** in 1915. Naturalized about San Francisco and Stockton. Native of Europe.

Lepturus incurvatus Trin.

Occasional along the seacoast. San Diego, **Abrams** in 1902. Santa Catalina Island, in a desiccated pond at Pebble Beach, **Parish** in 1916. Ventura, **Agnes Chase** in 1910. Santa Barbara, **Hitchcock.** Also at San Francisco. Native of Europe.

Hordeum gussonianum Parl.

"Occasional about the coast marshes." acc. Abrams' Flora Los Angeles. Warner's Ranch, **Hall** in 1910. Shoestring Mine, Antelope Valley, **Parish** in 1914. Reported to be frequent in northern California. Native of Europe.

Hordeum murinum L. Wall Barley.

Widely and abundantly naturalized in cultivated grounds, notably in overgrazed pastures, and in waste places; mostly in dry, sandy soils. Coming up abundantly in alfalfa fields in the spring, this grass injures the quality of the first cutting of hay. Throughout the state, and in 1890 reported by Hilgard to be "a fearful nuisance" in central California. Both this and the next species were quite as abundant thirty-five years ago as at present, and were probably early introductions. They have little value as pasturage, even when young, and are worse than worthless when dry. Native of Europe.

Hordeum nodosum L.

Distribution and abundance about as that of the last species, with which it often grows. Native of Europe.

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[15]For further notes on these bromes, see Parish, S. B. in Muhlenbergia, 5:109-113. 1909.

CYPERACEAE

Cyperus esculentus L. Chufa.

A troublesome weed in a few gardens, San Bernardino, **Parish** in 1882. Los Angeles, **Braunton** in 1902. Abundant at Covina, Azusa and El Monte, **Johnston** in 1918. Native of Eurasia.

Cyperus rotundus L. Nut-grass.

Santa Ana river-banks, near Colton, in sand, **Parish** in 1891. A troublesome weed in orange orchards. Upland, **Johnston,** and Riverside, **Reed,** both in 1918. Not reported from other parts of the state, but to be expected. Said to have first reached the United States with plants brought from Cuba to New Orleans. Native of tropical America and Europe.

Cyperus virens Michx.

In central California this sedge is considered indigenous, and so appears, but at San Bernardino it is certainly an introduction. A single plant appeared on the banks of Warm Creek, at the Mill street bridge, in 1907. The species is now abundant along ditches and by streams, throughout the valley.

PONTEDERIACEAE

Eichornia crassipes Solms. Water Hyacinth.

An occasional fugitive from cultivation. San Gabriel River, "established for a few years," **Mrs. Lawrence** in 1907. Los Angeles River, near Hynes, **Davidson** in 1904. Reservoir near Harlem Springs, San Bernardino Valley, and escaping down the spillway into Warm Creek, **Parish** in 1917. Native of tropical America.

LILIACEAE

Asparagus officinalis L. Asparagus.

An occasional fugitive from cultivation, often becoming established in damp soils. Birds eat the berries and disseminate the seeds. Native of Europe.

Asphodelus fistulosus L.

A waif, escaped from cultivation at a Mexican settlement, Bryn Mawr, near Redlands, **G. Robertson** in 1909. Native of the Mediterannean region.

URTICACEAE

Cannabis sativa L. Hemp.

A waif in an orange orchard at Upland, **Johnson** in 1918. Recently hemp has been cultivated in central California, but not in the south. Native of Asia.

Urtica urens L. Small Nettle.

A frequent weed in gardens and other cultivated grounds, and in waste places. Long naturalized throughout the state. Ventura, **Brewer** in 1861. Native of Europe.

POLYGONACEAE

Polygonum aviculare L. Knotgrass.

Abundantly naturalized on roadsides, about houses, in farmyards and waste grounds, but not in unbroken soils; probably early introduced. In the Mojave Desert, at Mojave Station, in 1915. Native of Eurasia.

Polygonum Convolvulus L. Wild Buckwheat.

Infrequent and local. Pasadena, **McClatchie** in 1894. Los Angeles, **Davidson** in 1894. Apparently commoner in central California; reported as "becoming common" at San Francisco in 1891.[16]

Fagopyrum esculentum Moench. Buckwheat.

Roadside casual at La Verne, Los Angeles Co., **Johnston** in 1918. Buckwheat is not cultivated in southern California. Native of Europe.

Rumex Acetosella L. Sheep Sorrel.

Adventive in lawns, Long Beach, **Parish** in 1891. Pasadena, "a few plants," **Davidson** in 1890. "Quite common in yards and by roadsides," at Claremont and Pomona, **Johnston** in 1918. Abundant at Santa Barbara, **Parish** in 1916. Riverside, **Reed** in 1918. Apparently recently naturalized in the south, where it is increasingly frequent in the coastal region. It is an abundant city weed in the Monterey district and about San Francisco, where it was reported as "common," by Hilgard in 1890. This widely distributed plant was found already established, if early records are to be credited, when the Pilgrims landed at Massachusetts Bay.[17] Native of Europe.

Rumex conglomeratus Murray. Green Dock.

Abundantly naturalized in damp soils in cultivated and waste grounds. In the Mojave Desert, on the river banks at Victorville in 1916. This species and the next are common throughout the state, and probably were early introduced. Both are natives of Europe.

Rumex crispus L. Yellow Dock.

Equally abundant in the cismontane region as the preceding species, and in like habitats. In the mountains it is infrequent about camps. Bear Valley, 6,500 ft. alt., **Parish** in 1917. In the Mojave Desert it is an infrequent weed. Barstow, **Parish** in 1915, and river banks at Victorville in 1916. Surprise Canon, **Hall & Chandler** in 1906.

Rumex pulcher L. Fiddle Dock.

"Sparingly introduced" at Inglewood, Los Angeles County, **Abrams,** about 1904, the only southern report. In central California a common weed of roadsides and waste places. San Jose and Berkeley, in 1919. Native of Europe.

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[16]Brandegee K. Zoe 2:371. 1892.

[17]See note to **Radicula nasturtium-aquaticum.**

Lastarrica chilensis Remy.

Common on dry mesas and slopes, but not in cultivated grounds. This is one of a group of plants common to Chile and California, whose status as indigenes or aliens has occasioned some difference of opinion among botanists. The weight of opinion favors its retention among the natives; but the most recent authority indicates it as "naturalized from Chile."[18]

CHENOPODIACEAE

Beta vulgaris L. Beet.

An escape from cultivation. Thoroughly naturalized and abundant in the streets of Santa Barbara, near the beach, **Parish** in 1916, 1918, and occasional in other coast towns; elsewhere a transient fugitive. Native of Europe.

Cycloloma atriplicifolium Coult. Winged Pigweed.

A recent introduction in San Bernardino County, rapidly becoming naturalized. Roadside between Colton and Bloomington, **Mrs. Wilder** in 1909, and **Parish** in 1914. Upland, **Johnston** in 1915, and Ontario in 1917. Abundant in a sandy wash near Bloomington, **Parish** in 1917. Not reported elsewhere in the state. Native of the central states.

Chenopodium album L. Lamb's Quarter. Pig Weed.

A common weed of cultivated and waste grounds; ascending the mountains to 6,000-7,000 ft. alt., San Jacinto Mts., **Hall** in 1901. San Antonio Mts., **Johnston** in 1917. Mojave Desert: Willow Springs, **Coville & Funston** in 1891. Colorado Desert: Mecca, **Parish** in 1913. The var, **viride** Moq. also occurs, but is less abundant. Native of Europe.

Chenopodium ambrosioides L. Mexican Tea.

A common naturalized weed, about dwellings, and in waste places. In the Mojave Desert, on the river banks at Victorville, **Parish** in 1916. Throughout the state. Collected on the Salinas River before 1856,[19] and at Los Angeles by **Brewer** in 1860. Native of tropical America.

Chenopodium ambrosioides L. var. **anthelminticum** Gray. Wormseed.

An infrequent weed of roadsides and waste places; less abundant than the species. Riverside, **Reed** in 1906. San Bernardino, **Parish** in 1912. Native of tropical America.

Chenopodium carinatum R. Br.

Locally adventive. Pasadena, "a recent introduction," **Grant** in 1906. Upland and Ontario, "abundant in places," **Johnston** in 1918. Better established in central California. Native of Australia.

Chenopodium murale L. Sowbane.

Abundantly naturalized in damp, mostly subalkaline soils, notably about habitations, and in waste places; probably an early introduction. In the Colorado Desert, an occasional weed about houses, at Brawley and Mecca, **Parish** in 1913. More abundant in the Mojave Desert. Furnace Creek and Resting Springs, **Coville & Funston** in 1891. Barstow, Needles and Leastalk, **Parish** in 1914, 1915. Common throughout the state. Native of Europe.

Chenopodium rubrum L.

"Sparingly naturalized at Nigger Slough and Ballona, Los Angeles County," acc. Jepson, Flora California. Also locally naturalized in central California. Native of Europe.

Rubieva multifida Moq.

An infrequent and local street weed in towns. Compton, **McClatchie** in 1895. Pasadena, **Grant** in 1904. Riverside, **Reed** in 1906. Upland, **Johnston** in 1906, and Ontario in 1918. The earliest notice in the state is San Francisco, "abundant," **K. Brandegee** in 1891. Native of Peru.

Atriplex Lindleyi Moq.

"Adventive, or escaped from cultivation, in San Diego County," acc. to Standley in N. Am. Fl. (1916). Native of Australia.

Atriplex rosea L.

Roadside at Ballona, Los Angeles County, **Chandler** in 1902, at the same place and date by **Braunton.** Woodland, Yolo County, **Hall** in 1916. Sparingly introduced on the Atlantic coast. Abundant in parts of central California and of Nevada. Native of Eurasia.

Atriplex semibaccata R. Br. Australian Salt-bush.

Introduced into cultivation about 1890 by the Department of Agriculture as a valuable forage plant, it did not prove to possess the expected value, and its culture was soon abandoned. It has now become thoroughly naturalized, especially along roads and in the streets of towns in damp, subsaline soils. San Bernardino, in 1905. San Diego, a most abundant weed, in 1916. In the Colorado Desert, abundant in towns and along roads in Imperial Valley, in 1913. The only northern collection seen is Marin County, **Eastwood** in 1901. Native of Australia.

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[18]Jepson, W. L. Fl. Cal. 389. 1914. For a discussion of the whole group see Parish, S. B., in Zoe 1:205-210. 1890.

[19]Torrey, J. Pac. R. Surv. 7, pt. 3:18. 1856.

Salsola Kali L. var. **tenuifolia** G. F. W. Meyer. Russian Thistle.

First noticed in the state at Lancaster, in the Mojave Desert, in 1895, where it was already widely diffused, and believed to have been introduced about ten years previously by cattle cars.[20] San Bernardino, first in 1891. Now frequent in stubble fields and pastures and along roadsides, and rare in unbroken grounds, but not proving so obnoxious as in some other parts of the country. Records in central California date between 1900 and 1911. Introduced in the United States at South Dakota in 1873.[21] Native of Russia.

AMARANTHACEAE

Amaranthus blitoides Wats.

Infrequent in cultivated soils. Santa Monica, **Davidson** in 1892, and Lancaster, Mojave Desert, in 1897. Rialto and Santa Monica, acc. Abrams' Flora Los Ang. Ontario region, **Johnston** in 1918. Occasional in central California. Native of Mexico and some of the western states.

Amaranthus deflexus L.

Abundantly naturalized in the streets of Santa Barbara, **Parish** in 1916. Adventive further south. Los Angeles, **Braunton** in 1902, and **Davidson** in 1918. Redondo, **Greata.** Along the railway, Ontario, **Johnston** in 1917, and Pomona in 1918. An abundant street weed in the Monterey and San Francisco regions, whence it probably reached the south. Native of Europe.

Amaranthus graezicans L. Tumble-weed.

Abundantly naturalized in cultivated and waste grounds. In the San Jacinto Mts., Strawberry Valley, 5,300 ft. alt., **Hall** in 1901. Mojave Desert; Panamint Mts., **Coville & Funston** in 1891. Victorville, **Parish** in 1913. Colorado Desert; Mecca, a few plants in a cultivated field, **Parish** in 1913. Native of Europe.

Amaranthus hybridus L. Green Amaranth.

A common weed in cultivated and waste grounds, and by roadsides. Native of tropical America.

Amaranthus retroflexus L. Pig-weed.

Distribution as of the preceding species, and like the last two, common throughout the state. Native of tropical America.

Alternantha achyrantha R. Br.

Los Angeles, **Nevin & Oliver** in 1884, and **Davidson** in 1892. Not otherwise known from the state. Native of Mexico.

PHYTOLACCACEAE

Phytolacca decandra L. Poke.

Santa Monica, a single plant, **Hasse** in 1860; not since collected, and probably a waif. Naturalized in some localities of central California. Ukiah, **Purdy** in 1907. Lake County, Vaslit. Native of the eastern states.

AIZOACEAE

Tetragona expansa Murr. New Zealand Spinach.

Abundant on the beach at Santa Barbara, **Parish** 1916, 1918. Also on the beaches at Monterey and San Francisco. A naturalized escape from cultivation. Native of the Australian Region.

Mesembrianthemum coccineum Haw.

A locally established escape in the hills near Del Mar, San Diego County, **Mrs. Spencer** in 1918. Not otherwise known in the state. Native of South Africa.

Mesembrianthemum edule L.

Commonly cultivated as a sand-binder about houses on the Los Angeles beaches, and escaping into the dunes. Playa del Rey, in 1918. Native of South Africa.

PORTULACACEAE

Portulaca oleracea L. Purslane.

Abundantly naturalized in cultivated and waste grounds. In the Colorado Desert, infrequent about habitations, at Brawley and Mecca, in 1913. Purslane is found throughout the world, except at high altitudes, a distribution not exceeded by any other cosmopolitan plant. From very early times it was in use as a pot-herb, and was cultivated for this purpose by the ancient Greeks,[21] as it long continued to be in Europe. It is reported to have been cultivated in Massachusetts in 1672,[22] and the spontaneous weed is occasionally boiled and eaten by the poorer Mexicans in California. Sir Joseph Banks, who observed it on the islands of Ascencion and St. Helena, accounts for its presence in such remote places, by "the ancient custom of the Portuguese, who, finding this herb particularly beneficial in complaints contracted in long voyages, made a point of sowing it wherever they went ashore."[23] It had certainly reached America before its discovery by Colum-

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[20]Shinn, C. H. Univ. Cal. Agric. Exp. Sta. Bull. 107:10-13. 1895.
[21]Dewey, L. H. U. S. Dept. Agric. Dept. Bot. Bull. 15:12. 1894.
[21]Theophrastus, Enquiry into Plants, VII, 1, 3; 2, 9. Hunt's Ed. 2:61; 75. 1916.
[22]Pammell, L. H. Weed Flora of Iowa. 763. 1913.
[23]Banks, J. Journal Voyage 1768-71. Hooker's Ed. 484. 1898.
[24]Navarrete. Coleccion de las Vieges 1:41. 1825. "Hallo verdolagos munchos."

ous. In his celebrated letter describing the events of his first voyage, Columbus mentions its abundance on the north shores of Cuba, October 17, 1492, only six days after he had first set foot on the New World.[24] Oviedo mentions "verdolagos o portulaca" as a familiar herb on the island of Hispaniola about 1526, and specifically states that it was already growing there before the arrival of Europeans, and that it was not introduced by them.[25] Other citations are given by Gray and Trumbell[26] from early writers showing the presence of purslane at several places in both South and North America at the time of the arrival of the earliest visitants. At later periods it at least preceded, rather than followed, the advance of settlements. While the Rocky Mountain region was still a wild and distant wilderness, inhabited only by Indians, purslane was so abundant on the upper Mississippi that Nuttall [27] considered it indigenous there and in 1820, James found it "one of the most frequent plants" about the sources of the Red River.[28] I find nothing to indicate its presence in California before the Pioneer Period, and it was perhaps introduced at that time. Purslane is not enumerated in Bolander's Catalogue of San Francisco Plants,[29] and in Behr's Flora of the same district[30] it is noted only as "an escape from cultivation." According to Decandolle[31] purslane originated in Western Asia, Russia and Greece.

CARYOPHYLLACEAE

Cerastium viscosum L. Mouse-ear Chickweed.

Occasionally in lawns and shady grounds, mostly in the coastal region. San Diego, **Orcutt** in 1884. Santa Monica and Los Angeles, **Davidson** in 1893. Witch Creek, **Alderson** in 1898. Temecula, **Hall** in 1898. Throughout the state. Native of Europe.

Stellaria media Cyr. Chickweed.

Abundantly naturalized in shady places, notably about habitations, in early spring. Native of Europe.

Sagina apetala Ard. Pearlwort.

Abundant in a city lot at Pasadena, **Grant** in 1917. The only other Californian collection seen was from Jackson, Amador County, **Hansen** in 1892. Native of Europe.

Arenaria serpyllifolia L. Sandwort.

Claremont, in lawns, **Johnston** in 1918. Infrequent in the state. Native of Europe.

Spergula arvensis L. Spurry.

Abundantly naturalized in lawns, gardens, and by waysides, at Santa Barbara, **Parish** in 1916. Further south it is infrequent in the coastal region. San Diego, **T. S. Brandegee** in 1901. Pasadena, **Davidson** in 1892. An abundant weed in the Monterey and San Francisco region. Native of Europe.

Polycarpon tetraphyllum L.

Frequent in crevices of pavements, Santa Barbara, **T. Payne** in 1920. Occasional in towns in the Bay region. Native of Europe.

Vaccaria vulgaris Host. Cow-herb.

An occasional waif, usually in grain fields, or farmsteads. San Diego, **Orcutt** in 1884. Near San Bernardino, **Parish** in 1891. Sierra Madre, **Davidson** in 1908. Highland, **Parish** in 1917. Upland, and San Antonio Canon, 4,000 ft. alt., **Johnston** in 1917. Mojave Desert, near Baxter, a single plant by the railway, in 1915. Native of Europe.

Agrostemma Githago L. Corn Cockle.

An infrequent waif in grain fields or orchards, San Bernardino, in 1912. Colorado Desert; Imperial Valley, a single plant, in 1913. Native of Europe.

Silene gallica L. English Catchfly.

Thoroughly and widely naturalized as a ruderal weed, and more abundantly in feral grounds; probably an early introduction. Native of Europe.

Silene noctiflora L. Night-blooming Catchfly.

Alhambra, in lawns, **Davidson** in 1908. Native of Europe.

Lychnis alba Mill. White Campion.

In lawns at Claremont, **Miss M. S. Walton** in 1916. and Upland, **Johnston** in 1917. Not otherwise known from the state. Native of Europe.

Spergularia rubra J. & C. Presl.

Claremont, **Johnston** in 1918, and **Parish** in 1919. Native of Europe.

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[25]Oviedo. Hist. Gen. y Nat. Indias. 1535.
[26]Am. Jour. Sci 3d Ser. Gray's Scientific Papers 1:226. 1889.
[27]Nuttall, T. Gen. 2:6. 1818.
[28]James E. Acc. Long's Exped. to Rocky Mts. in 1819-20. 2:68. 1823
[29]Bolander, H. N. Cat. Pl. Vicinity of San Francisco. 1870.
[30]Behr, H. Flora Vicinity of San Francisco. 196. 1888.
[31]Decandolle, A. Orig. des Plantes Cult. 70. 1883.

CRUCIFERAE

Lobularia maritima Desv. Sweet Alyssum.

Along streets, an occasional escape from cultivation. Native of Europe.

Lepidium Draba L. Hoary Cress.

Recently introduced, but locally naturalized and increasing. Los Angeles, in Chinese gardens, **J. W. Minthorn** in 1910. Huntington Beach, **Davidson** in 1916. Abundant in grain fields near Chino, **Johnston** in 1918. Smeltzer, Orange County, **Roy K. Bishop,** first seen in 1911, now (1919) a troublesome weed in peat lands. Ventura, a recent introduction, **Essig** in 1918. Local and infrequent in the state. Native of Europe.

Lepidium perfoliatum L. Tumble mustard.

Recently introduced, now widely distributed, but apparently nowhere abundant, collectors usually noting single or few plants. Hollywood, **Davidson** in 1910, **Moxley** in 1917. Orange, **Mrs. Bradshaw.** Point Loma, a single plant, **Parish** in 1913. Antelope Valley, Mojave Desert, **Miss Marjory Shaw** in 1917. Widely disseminated, but not abundant throughout the state. The earliest reference seen for the United States is as a ballast plant at New York in 1888.[32] Native of Europe.

Coronymus didymus Ludwig. Wart Cress.

Pasadena, **Studebaker** in 1901, the only southern station known; perhaps a waif. Infrequent in the state. Native of Europe.

Capsella bursa-pastoris Medic. Shepherd's Purse.

A winter and spring annual, everywhere abundant in orchards, gardens and waste grounds. In the Mojave Desert, rare at Victorville and Needles in 1913. Native of Europe.

Camelina sativa Crantz. False Flax.

In a grain fields, Redondo, **McClatchie** in 1897, the only southern record. Apparently rare in the state, but in Oregon it was early introduced in the Columbia River settlements, where in 1843 it was reported to be rank in the grain fields.[33] Native of Europe.

Raphanus Rhaphanistrum L. Jointed Charlock.

In the south a rare weed in waste places. Los Angeles, "two plants," **Davidson** in 1902. San Diego, **Cleveland** in 1903. Colton, "a single plant," **Reed** in 1908. Proba. bly a recent introduction into the state. San Francisco, 1894, and still rare in 1911,[34] but now frequent in that region, **Parish** in 1918. An abundant street weed at Pacific Grove in 1917, as is the next species. Native of Europe.

Raphanus sativus L. Radish.

Naturalized in waste and cultivated grounds; often abundant and injurious in grain fields. A recent introduction in the south. Infrequent at San Bernardino as late as 1896. Throughout the state. According to Hilgard "one of the common weeds of Berkeley" in 1910, while **R. Raphanistrum** was "not present." Native of Europe.

Brassica alba Boiss. White Mustard.

Reported as "not uncommon" at Santa Monica, by **Hasse** in 1890, but not seen by more recent collectors, and perhaps an erroneous determination. Native of Europe.

Brassica adpressa Moench.

Locally and sparingly naturalized. San Bernardino, rare in 1914, and little increased in 1918. Streets of Los Angeles, **Davidson** in 1909, and "fairly common" in 1913. Rather common in a few localities in Redlands in 1918. An abundant street weed in the San Francisco region. Native of Europe.

Brassica campestris L. Rutabaga.

Freely naturalized in fields and waste places and along roads. Native of Europe.

Brassica Napus L. Rape.

A waif in a field at Highland, San Bernardino valley, in 1917. Not otherwise reported from the state. Native of Europe.

Brassica nigra Koch. Wild Mustard.

Abundantly naturalized as a ruderal weed and in grain fields. In the coastal district, in the rich adobe soil of the hills and mesas, it often covers wide areas with a close growth 5-10 feet high, excluding all other vegetation. It is sometimes harvested for the seed. In the Colorado Desert a few plants were seen by the roadside in Imperial Valley in 1913. In the Mojave Desert, at Surprise Canon, **Coville & Funston** in 1891. Native of Europe.

It was certainly introduced during the Mission era, and there is a persisting tradition among some Spanish-speaking Californians that the mission fathers were accustomed to carry the seed with them, and to sow it by the wayside. This seems improbable, but the fathers no doubt grew the plant in their gardens, as the young leaves are relished by the Mexicans, and others, too, as a pot herb. The seeds would be scattered by the small birds, who freely eat them.

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[32] Cat. Anth. & Pterid. within 100 miles of N. Y. 78. 1888.

[33] Geyer, C. A. In London Jour. Bot. 5:512. 1846.

[34] Jepson, W. L. Fl. W. Mid. Cal., 2d Ed. 185. 1911.

Diplotaxis muralis DC. Sand Rocket.

Well established for half a block on Eighth street, San Bernardino, in 1914, persisting, but little increased in 1920.

Diplotaxis tenuifolia DC. Wall Rocket.

Locally adventive. Pasadena, **Grant** in 1901, 1905. Los Angeles, **Davidson** 1895. persisting, but little increased in 1920. Native of Europe.

Conringia orientalis Dumont. Hare's-ear Mustard.

A few plants in an orange orchard at Upland, **Johnston** in 1918. Native of Europe. The last three species are known from the state only as here noted.

Sisymbrium altissimum L. Tumble Mustard.

A recent immigrant which has spread with great rapidity and is now thoroughly naturalized, and in many places abundant and pernicious, both in cultivated and wild grounds. Hollywood, **Davidson** in 1910, Laurel Canon in 1911, and Sierra Madre in 1912, in each case only a single plant, San Bernardino, a single plant in 1912, and quite abundant in a field at Redlands in 1913. In San Antonio Mts. at 5,750 ft. alt., **Johnston** in 1917. Abundant along the roadside at Adelanto, Mojave Desert, **Parish** in 1918. The first recorded appearance of this weed in North America was at Castle Mountain, in the Canadian Rockies, in 1883.[35] Native of Europe.

Sisymbrium Irio L.

Well established in some orange orchards at Upland, Johnston in 1918. Not otherwise known from the state. Native of Europe.

Sisymbrium officinale Scop. Hedge Mustard.

A common weed of roadsides and waste places; ascending the San Bernardino and San Antonio mountains to 5,000 ft. alt. First appeared at San Bernardino about 1885. Frequent throughout the state. Native of Europe.

Mathiola incana R. Br. Garden Stock.

Escaped along the bluffs at Laguna Beach, **Crawford** in 1916. Carlsbad, "abundantly escaped," **L. Street.** Native of Europe.

Radicula nasturtium-aquatica Britten & Rendle. Watercress.

Abundantly naturalized about streams and springs; ascending the mountains to at least 5,000 ft. alt. In the Mojave Desert at Victorville, Rabbit Springs, and Postoffice Springs in 1915, 1916. Native of Europe. The watercress may have reached North America previous to European settlement. Its abundant seeds are shed on the muddy banks whereon it grows, and may be carried to great distances by migratory waterfowl, and by the same agency distributed from pool to pool, as is probably the case with the seeds of other widely distributed aquatic plants. It is reported in early accounts to have been growing about Massachusetts Bay when the Pilgrims landed, or, at least, shortly after.[36] There is more abundant and satisfactory evidence of its establishment in Arizona and Southern California before the earliest Spanish explorations. The contemporary account of Coronado's famous expedition[37] states that watercresses were "growing in many springs" at Chichilticalli, an Indian village on the Gila, near which they camped in 1541, the site of which has been identified with that of the modern Solomonsville in Graham County. The first Spanish entrance into California Alta was at San Diego, May 14, 1769, where the earliest Mission was founded. On the 14th of the ensuing July an expedition was dispatched, under Don Caspar Portola, to explore the unknown wilderness to the north, which eventually, after a long and arduous journey, reached and discovered the bay of San Francisco. Portola's own diary is brief and bare, but the diaries of the chaplain, Fr. Pedro Crespi, and of the engineer, Alferez Miguel Costanso, contain some interesting information concerning the vegetation of the strange land through which they passed. July 30th they were at a place 39 leagues from San Diego, which they named Valle de San Miguel, satisfactorily identifiable as the neighborhood of the subsequent Mission San Gabriel. Here they camped by a runlet of water whose banks were covered with watercresses.[38] August 3rd, three leagues beyond the Los Angeles river, and in the present San Fernando valley, camp was made in a grove of alders, by a spring whose marshy borders were overgrown with watercresses and other herbs.[39] The next day they were at two springs from which flowed a stream full of watercresses.[40] They were in the same region on the return journey, and January 13th,

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[35]Hill, E. S. In Torreya 9:96. 1909.

[36]"Also divers excellent pot-herbs grow abundantly, as . . . watercress, Sorrel. Higginson, F. New England Plantation, 1630. Reprinted in Young's Chronicles first Planters Mass. Bay 246. Chron. Pilgrim Fathers 132, 165. Concerning these records see Parish, S. B., in Rhodora 3:17, 1901, and Robinson, J. Ibd. 4:81, 1902.

[37]Castanado, Pedro de. Narrative Exped. of Coronado, 1540-42, 1598. Eng. Translation in Spanish Explorers in southern U. S. 349. 1907.

[38]"Sentamos el real junta a un zanja de agua corriente, cubiertos sus orillas de berros y cominos." Costanso, M. Diario del Ciage de Tierra hecho al Norte de la Cal. 1769-70. Publ. Acad. Pac. Coast Hist. 21:78. 1911.

[39]"Era este un manantial dentro de un bagial . . . y estaba cubierto de zacatal, olerosas herbas y berros." Costanso. Op. cit. 2:180. "Un lunar de alisos . . . y de esos sale un ojo de agua del grosor de un buey, y esta las orrillas enzacatadas y vestidas de olerosas herbas y berros." Crespi, P. Viage de Tierra hecho de San Diego a Monterey. In Palou, Noticias de Neuva Cal. 2:125. San Francisco. 1874.

[40]"Estan ambos poblados de berros." Crespi, Op. cit. 2:126.

1770, they ascended a stream whose source was a large spring ,covered with watercresses.[40] Mission San Gabriel was founded in September, 1771, and when Fr. Font visited it, January 6, 1770, only seven years after the first arrival at San Diego, he found watercresses growing in a stream.[41] This was in Costanso's Valle de San Miguel. In Oregon, also, watercresses may have anticipated the white settlement, for they are reported as found by the Lewis and Clark Expedition in the Multnomah valley in April, 1806.[42] Piper is of opinion that the plant seen was some undesignated species of Cardamine, but there are only two Cardamines which grow in the habitat indicated, neither of which would be likely to be mistaken for so familiar an herb as the watercress, which probably was the plant really seen by the explorers.

CAPPARIDACEAE

Cleome lutea Hook.

A casual introduction, in impure seed, in an alfalfa field at Downey, **Davidson** in 1894. Native of western America.

Cleome serrulata Pursh. Stinking Clover.

A single waif in the railway yards at Barstow, in the Mojave Desert, in 1914. Native of western America.

FUMARIACEAE

Fumaria officinalis L. Fumatory.

Well established in some orchards at Ontario and Upland, **Johnston** in 1917. The only other collection seen from the state is; San Luis Obispo, "well established in an old orchard," **Condit** in 1909. Native of Europe.

RESEDACEAE

Reseda alba L.

An occasional roadside waif. Pasadena, **Davidson** in 1893. Ojai, **Hubby** in 1902. San Bernardino, **Parish** in 1904. Native of Europe.

Reseda lutea L. Yellow Mignonette.

"An occasional escape from gardens" acc. to Abrams' Flora of Los Angeles. Native of Europe.

Reseda odorata L. Sweet Mignonette.

Cultivated and occasionally escaping. Native of Europe.

LEGUMINOSAE

Hoffmanseggia drepanocarpa Gray.

Locally adventive in Los Angeles County. Alhambra, in an alfalfa field, **Davidson** in 1896, and abundant in fields at Coyote Pass, in 1918. Near Los Angeles, **T. L. Minthorn** in 1909. Native in the Colorado Desert and eastward to New Mexico.

Gladitschia triacantha L. Honey Locust.

Casual on the San Gabriel river, **Johnston** in 1918. Native of the middle western states.

Ulex europeus L. Furze.

An escape along the bluff at Playa del Rey, **Davidson** in 1911, and **Johnston** in 1917. At San Francisco, "covering many acres," **K. Brandegee** in 1892. Native of Europe.

Cytisus canariensis L. Broom.

An infrequent escape from cultivation. Arroyo Seco, Pasadena, **Davidson** in 1896. Blanchard's Park, Claremont, **Johnston** in 1918. Native of the Canary Islands.

Alhagi camelorum L. Camel's Thorn.

Colorado desert; Mecca, **Brandegee** in 1915. Said to be troublesome at Brawley, 1920. Native of Asia.

Medicago hispida Gaertn. Bur-clover.

Probably introduced in the mission period; abundantly naturalized on wild lands and a common weed in cultivated grounds. A valuable forage plant, not much relished by stock when green, but readily eaten and very nutritious when naturally cured on the ground, in which state it was often, in early days, raked up and stacked as hay. Even after animals have consumed the dried stems and leaves they do well on the abundant "burs," which they lick up from the apparently bare ground. It was reported as "abundant throughout California" in 1859.[43] Native of the Mediterranean region.

Medicago hispida Gaertn. var. **apiculata** Urban.

East Los Angeles, **Davidson** in 1903. Pasadena, **Grant** in 1905. Claremont, **Johnston** in 1918. Infrequent throughout the state. Native of Europe.

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[40] "Un arroio cuio nacimiento era un ojo muy grande cubierto de berros." Costanso. Op. cit. 2:314.

[41] "Abundance of watercresses, of which I ate enough." Font's Diary, quoted in Garces' Diary and Itenerary, Cowes' Transl. 2:261.

[42] "Among the plants in this valley in which we are encamped, I observed . . . the watercress." Clark's Journ. in Lewis & Clark's Original Journals. Thwait's Ed. 4, pt. 2:274. 1905. Footnote by C. V. Piper. "Along the river bottoms grow luxuriantly the watercress . . ." Lewis & Clark's Exped., Chicago Ed. 2:238. 1903.

[43] Torrey, J. Bot. Mex. Bound. Surv., 53. 1859.

Medicago lupulina L. Black Medic.

A recent immigrant, first appearing in lawns, now abundantly naturalized there and by grassy roadsides in damp soil. Los Angeles, **Davidson** in 1891. Redlands, **Parish** in 1906, San Bernardino in 1908, and abundant at Santa Monica in 1918. Native of Europe.

Medicago orbicularis All.

In a field near Santa Monica, **Helen D. Geis** in 1902. Reported otherwise from the United States only as a ballast plant at New York, 1888.[44]

Medicago sativa L. Alfalfa.

Extensively cultivated, and an occasional fugitive. First cultivated in California about 1854, and reported to have been introduced from Chile. Native of Europe.

Melilotus alba Lam. Bokhara Clover.

Recently introduced, supposedly in alfalfa seed, and now abundantly naturalized in fence rows ,and in cultivated and waste grounds. Buckman's Spring, San Diego County, in a cultivated field, **Cleveland** in 1890. San Bernardino, **Parish,** rare in 1890. Los Angeles, **Davidson,** "two plants," in 1891. The earliest northern collections are: San Francisco, **K. Brandegee** in 1891, and Clear Lake, **Jepson** in 1892. Native of Eurasia.

Melilotus indica All. Sour Clover.

Abundantly naturalized in cold ,damp soils, where it sometimes forms a pure stand. Probably dates from the mission period. The earliest report is Los Angeles, in 1856.[45] Now sometimes grown as a soiling crop in orchards. Native of Eurasia.

Trifolium procumbens L. Hop Clover.

By a stream, in Potato Canon, above Redlands, well established in 1894. Native of Europe.

Trifolium repens L. White Clover.

Often sown in lawns. and infrequently escaping. Native of Europe.

Cicer arietinum L. English Chickpea.

"Among the native shrubbery at San Gabriel," **Davidson** in 1903; the only reported occurrence in the state. Native of Europe.

Vicia sativa L. Spring Vetch.

Infrequent, and apparently transient. Los Angeles, **Davidson** in 1890. Pomona, **Davy** in 1896. San Bernardino, **Parish** in 1906. Occasional in central California, where the earliest collection is: Sonoma, in fields, **Brewer** in 1862. Native of Europe.

Vicia villosa Roth. Winter Vetch.

Grown in orange orchards as a soiling crop; thence an occasional fugitive. Fontana, near Rialto, **Johnston** in 1918. Native of Europe.

GERANACEAE

Erodium Botrys Bartoloni.

Infrequent, and mostly near the coast. San Diego, **W. M. Sheldon** in 1904. Ramona, **K. Brandegee** in 1906. Perris, **Parish** in 1914. Common in central California. Native of the Mediterranean region.

Erodium cygnorum Nees.

Locally established at a single station near San Diego, **Mrs. Spencer** in 1916. The only reported collection. Native of Australia.

Erodium cicutarium L'Her. Filaree.

Widely distributed and abundant in both cultivated and feral grounds; ascending the mountains to 5,000 ft. alt. In the Colorado Desert, in irrigated fields at Mecca, in 1913. In many parts of the Mojave Desert, and extending into adjacent Nevada, it is abundant over large areas of high mesa, at 3,000-4,000 ft. alt. Elsewhere in this desert it is infrequent in cultivated grounds. Native of the Mediterranean region.

Erodium moschatum L'Her. Filaree.

Distribution of the preceding species, except for the mountains and deserts. Native of the Mediterranean region.

These two Erodiums are abundant throughout the state, and are valuable forage plants, both while green, and when naturally cured on the ground. In the latter state they were often raked up for hay in early days. **E. moschatum** is less relished by stock, at least when green, than the other species, and is said to give a bad taste to milk. It prefers the richer and more clayey soils, and **E. cicutarium** those which are light and sandy; but these preferences are not prohibitive, but simply determine the abundance of either species in a particular soil. **E. cicutarium** is the more tolerant of soil variations and aridity, and consequently the more widely distributed of the two species. The carpels of filaree are admirably adapted to transportation in the pellage of animals, and there can be no doubt of its very early introduction into the state. Fremont[46] states that in 1844 **E. cicutarium** "covered the ground like a sward" in the Sacramento valley, where squaws were

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[44]Cat. Anth. & Pterid. within 100 miles of N. Y., 78. 1888.

[45]Torrey, J. Pac. R. Rept. 7, pt. 3:9. 1856.

[46]Fremont, J. C. Second Report 243, 253. 1845.

gathering the seeds for food, and as he passed through the lower San Joaquin Valley he found "instead of grass, the whole surface of the country closely covered with it." In 1856 it was "common in New Mexico and throughout Sonora and California;"[47] so that Thornber[48] is probably mistaken in dating its introduction into Arizona in 1870-71. It is widely scattered throughout the United States, but apparently nowhere so abundant as on the Pacific coast, whence it was probably introduced elsewhere.

Pelargonium clandestinum L'Her.

In a neglected lawn at Santa Ana, **Nevin** in 1904, the only reported collection. Native of Europe.

Pelargonium zonale Willd. Scarlet Geranium.

Fugitive in the hillside chaparral, Oceanside, in 1897. Native of South Africa.

Geranium pyreniacum L.

A casual on the Vivian creek trail, San Gorgonio Mt., 7,000 ft. alt., **G. Robertson** in 1905. The presence of this plant, so far from habitations or traveled roads, is remarkable. The only other reported collections were made at Quebec and Bethlehem, Penn. Native of Europe.

OXALIDACEAE

Oxalis corniculata L.

A recent immigrant, now abundantly naturalized in lawns and parkings, both the green-leaved and purple-leaved forms. San Bernardino, **Parish** in 1900. San Diego, **Hall** in 1903. Santa Barbara, **Eastwood** in 1908. Probably at an earlier date in central California. Native of Europe.

Tropaeolum majus L. Nasturtium.

In common cultivation and occasionally escaping. Native of Peru.

LINACEAE

Linum usitissimum L. Flax.

Casual and infrequent. Redlands, in 1891. Los Angeles, **Davidson** in 1893. Not cultivated in this region. Native of Europe.

ZYGOPHYLLACEAE

Tribulus terrestris L. Puncture Weed.

A recent introduction along the Southern Pacific Railway, now naturalized and abundant along railroads and highways, but not confined to those habitats. Railway embankments, Port Los Angeles, **Davidson** in 1903. Railway yards, Colton, abundant, **Parish** in 1908. Near the railway, San Bernardino, a single plant, **W. G. Wright** in 1908. Bakersfield, **C. P. Fox** in 1905, in which region it is now "one of the two worst weeds."[49] In the Colorado Desert, frequent along railways and streets and in lawns. An obnoxious weed; when growing by roadways the long stems extend over the track, and the abundant caltropiform fruits work into the tires of bicycles, and even of automobiles, and cause punctures. Native of Europe.

RUTACEAE

Ruta chalapensis L. Rue.

An escape or fugitive from Mexican gardens, where cultivated as a medicinal herb. El Monte, **Davidson** in 1894; Mexican quarter, Ventura, **Parish** in 1918, and Monterey in 1917. Native of tropical regions.

SIMARUBACEAE

Ailanthus glandulosa Desf. Tree of Heaven.

Occasional in waste places. Seldom cultivated. Native of China.

EUPHORBIACEAE

Chamaesyce maculata Small. Milk Purslane.

Street weed at Pasadena, "recently introduced." **Grant** in 1904. Native of Europe.

Tithymalus Peplus Gaertn. Small Spurge.

Recently introduced, but now naturalized and abundant in city lawns and yards. San Bernardino, rare in 1895; San Diego, abundant in 1914. Native of Europe.

Ricinus communis L. Castor-oil Plant.

In waste places, often becoming a small tree, and sometimes forming small groves. Its distribution and persistence are limited by its susceptibility to occasional low temperautres, by which the plants are killed. Formerly occasionally cultivated as a crop, and some forms are grown for ornament. Native of the tropics.

MALVACEAE

Abutilon Theophrasti Medic. Velvet-leaf.

A waif in an orange orchard at Riverside, **Gordon Surr** in 1917, the only reported collection from the state. Native of India.

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[47]Torrey, J. Bot. Mex. Bound. Surv. 41. 1859.
[48]Thornber, J. Plant World 10:206. 1907.
[49]Bull. Cal. State Hort. Com. 6:431. 1917.

Modiola caroliniana C. Don. Bristly Mallow.

A ruderal weed in damp soil and along ditches. Los Angeles and Compton, **Davidson** in 1892. San Bernardino, **Parish** in 1895. Riverside, **Reed** in 1914. Claremont, **Johnston** in 1917. Infrequent in California. Native of tropical America.

Malva borealis Wall. Mallow.

Rare in cultivated ground, Old San Bernardino, in 1891. Along Ballona Creek, near Mesmer, Los Angeles County, **Abrams** in 1904. Native of Europe.

Malva parviflora L. Mallow.

An abundant naturalized weed in cultivated and waste grounds; probably an early introduction; often troublesome because of its rank growth. The earliest record is San Diego, **J. G. Cooper** in 1862. Native of Europe.

Hibiscus Trionum L. Flower-of-an-hour.

A waif in an orange orchard at Riverside, **Gordon Surr** in 1917. The only California record. Native of the tropics of the Old World.

TAMARICACEAE

Tamarix gallica L. Tamarix.

Frequent in cultivation as an ornamental shrub, occasionally escaping and establishing itself on the banks of streams. In Death Valley it abundantly borders Furnace Creek (**Parish** in 1915), spreading from a planting at the head of the stream. Native of Eurasia.

Tamarix Pallisii Desv.

Single shrub on the borders of Salton Sink, at Travertine Terraces, Colorado Desert, in 1916. Native of Eurasia.

CACTACEAE

Opuntia ficus-indica Mill. Tuna.

Opuntia Megacantha Salm-Dyck. O. Tuna Auth. not Mill. Tuna.

Both these opuntias were introduced from Mexico by the mission fathers at an early date. They were much used as hedge plants at the missions and old Mexican habitations, about some of which they still persist, or sometimes mark the site of buildings which have disappeared. They were also valued for their fruit, which is still eaten by children. Both species are naturalized in the hills about Santa Barbara, and are occasionally seen in cultivation. Native of America.

ONAGRACEAE

Gaura sinuata L.

In a bean-field at Camarillo, Ventura County, and in an apricot orchard near Ventura, **A. A. Brock** in 1916. Only a small patch in either place, and both believed to have been exterminated. Established in a vacant lot at Pasadena, **C. F. Saunders** in 1920. Not reported elsewhere in the state. Native of the southwestern states.

UMBELLIFERAE

Daucus Carota L. Carrot.

San Bernardino, **Parish** in 1890, a few plants along a roadside, increasing for a few years, and then becoming extinct. Los Angeles, **Davidson** in 1896. Claremont, **Chandler** in 1897. Riviera, **Braunton** in 1892, and Playa del Rey in 1903. Fortunately our climate appears unsuited to this obnoxious weed, which is here a garden escape, which fails to permanently establish itself. According to Hilgard it was "conspicuous" in the San Francisco region in 1890, but it does not so appear at present. Native of Europe.

Coriandrum sativum L. Coriander.

Los Angeles, an infrequent escape from cultivation, **Hasse** in 1888. San Diego, **Brandegee** in 1894. Native of Europe.

Pastanaca sativa L. Parsnip.

Locally frequent in damp soil by roadsides and in waste places. Edgar Canyon, near Redlands, **Parish** in 1882. San Bernardino, rare by roadsides in 1885, now frequent. An escape from cultivation. Native of Europe.

Caucalis nodosa Hudson.

Oak Knoll, Pasadena, **McClatchie** in 1894. Infrequent in central California, where the earliest reported collection was from Folsom, in 1883. Native of Europe.

Foeniculum vulgare Hill. Fennel.

Recently introduced in the south, and now abundantly naturalized by roadsides, along fences, and in waste places. Los Angeles, "a casual," **Davidson** in 1898. San Bernardino, rare in 1890. Ballona, **Chandler** in 1902. Claremont region, and Elsinore, **Johnston** in 1918. Frequent throughout the state, and according to Hilgard "conspicuous" in the Bay region in 1890. Native of Europe.

Conium maculatum L. Poison Hemlock.

Pasadena, **McClatchie** in 1894. Los Angeles, **Davidson** in 1894, and still infrequent in 1918. Introduced into ornamental cultivation, under the name of "Carrot Fern," at San Bernardino, about 1905: soon escaping, and now frequent in waste places, and abundantly naturalized in willow thickets along the Santa Ana River, near Colton. Widely distributed in localities throughout the state, but probably of recent introduction. The earliest collections seen are: Berkeley, **Davy** in 1893, and Truckee, **Sonne** in 1897. Native of Europe.

Apium graveolens L. Celery.

An early immigrant, long naturalized and abundant in many parts of the state, in damp, subalkaline soils. Native of Europe.

PRIMULACEAE

Anagallis arvensis L. Pimpernel.

Abundantly naturalized in damp soils about habitations, by roadsides, and in meadows; apparently an early immigrant. "Common about Los Angeles and in many other places in California, . . . completely naturalized." San Gabriel and San Bernardino, **Antisell** in 1856.[50] Santa Barbara and Ventura, **Brewer** in 1861. Frequent throughout the state. Native of Eurasia.

Anagallis arvensis L. var. **coerulea** Ledeb.

Infrequent and seldom collected. Fallbrook, **Cleveland** in 1884. Los Angeles, not rare, **Davidson** in 1918. Native of Eurasia.

ASCLEPIADACEAE

Araujia sericifera Bert.

Occasionally cultivated, and a fugitive at Riverside, **Reed** in 1914, and increasing in 1918. Not otherwise known from the state. Native of Persia.

CONVOLVULACEAE

Ipomoea hirsutula Jacq. Mexican Morning-glory.

A few plants in an orange grove at Riverside, **Gordon Surr** in 1915; the only collection in the state known to me. Native of Mexico.

Ipomoea purpurea Roth. Morning-glory.

An escape from cultivation; frequent in cultivated and waste grounds, sometimes a pernicious weed in vineyards, orchards and gardens, where, once established, it is extirpated only by persistent effort. Native of tropical America.

Convolvulus arvensis L. Field Morning-glory.

Naturalized in many places in fields and by roadsides; a troublesome weed, difficult to eradicate. San Bernardino, **Parish** in 1890, and Descanso in 1897. Los Angeles, **Davidson** in 1903. More abundant in the Bay region, where it takes entire possession of large tracts of rich alluvial soil; and is characterized as "the most troublesome orchard and garden weed yet naturalized in California."[51] Native of Europe.

Convolvulus pentapetaloides L.

Locally naturalized near the coast. Sweetwater Valley, **Cleveland** in 1884. San Diego, **T. S. Brandegee** in 1902. La Jolla, **Clements** in 1914. San Pedro, **C. Russell** in 1903. Redondo, **Davidson** in 1902. Infrequent northward. Native of Eurasia.

BORAGINACEAE

Lappula Myosotis Moench. Stickweed.

A casual at Santa Monica, **Hasse** in 1906. Not otherwise known from the state. Native of Eurasia.

Lycopsis arvensis L. Small Bugloss.

A recent immigrant, locally established by a roadside at Upland, **Johnston** in 1917, 1918. Not otherwise known from the state. Native of Eurasia.

LABIATAE

Marrubium vulgare L. Hoarhound.

Abundantly naturalized, not only as a weed in waste and neglected grounds and by roadsides, but frequent on arid hills and mesas; sometimes gathered in quantity for the wholesale drug trade. Infrequent on the borders of the Mojave Desert at Victorville in 1915. Throughout the state. Probably an early escape from cultivation as a medicinal herb. Native of Europe.

Nepeta Cataria L. Catnip.

Infrequent about habitations. Near Beaumont, 2,500 ft. alt., **Parish** in 1880, and at San Bernardino in 1886. Piru Creek, **Davidson** in 1889. Lone Pine, San Antonio Mts., 4,500 ft. alt., **Hall** in 1895. Riverside, **Reed** in 1918. Rare in California, escaping from cultivation as a medicinal herb. Native of Europe.

Lamium amplexicaule L. Henbit.

Well established by a moist roadside near Claremont, **Johnston** in 1918. Infrequent and local in central California. Native of Eurasia.

Mentha citrata Ehrh. Lemon Mint.

Locally adventive. San Bernardino, on the banks of Town Creek, in 1903, and in a marsh on the banks of the Santa Ana River in 1907, much increased in 1918. In the Colorado Desert at Mecca, along a drainage ditch, in 1913. Native of Europe.

Mentha piperita L. Peppermint.

Infrequent and local. Los Angeles river-bed, **Davidson** in 1891. Sherman, **Grant.** Native of Europe.

Mentha rotundifolia Huds. Wooly Mint.

A local escape from cultivation, but maintaining itself and increasing. Los Angeles, **Davidson** in 1896. San Bernardino, by a marshy roadside, in 1904. Stream banks in Waterman Canyon, San Bernardino Mts., at Vail's, 2,000 ft. alt., in 1916. Native of Europe.

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[50] Torrey. J. Pac. R. Rept. 7, pt. 3:14. 1856.
[51] Jepson. W. L. Fl. W. Middle Cal. 2d Ed. 326. 1911.

Mentha spicata L. Spearmint.

Abundantly and widely naturalized along streams and ditches and in other wet places; an escape from cultivation. In the San Jacinto Mts. at Thomas Valley, 4,500 ft. alt., **Hall** in 1898. Native of Europe.

SOLANACEAE

Solanum eleagnifolium Cav. White Horse-nettle.

A recent immigrant along the Southern Pacific railway, and as yet most frequent along tracks. Corona, "well established along the railroad," **W. J. Lester** in 1895. Railroad tracks at Compton and San Pedro, **McClatchie** in 1896. Ventura, **E. M. Day** in 1896. Oceanside, along the railroad tracks, **Parish** in 1897. Los Angeles, "at a single station," **Braunton** in 1902. Along the railroad at Chino, **Johnston** in 1918. San Diego, **Miss Woodcock** in 1919. In the Colorado Desert, at Niland, by the railroad tracks, **Parish** in 1913. Northward at least to Fresno, **J. E. Hughes** in 1896. Native of Arizona and eastward.

Solanum nigrum L. Nightshade.

Infrequent and local. Riverside, **Reed** in 1906. Roadside at a ford over the Santa Ana River, **Parish** in 1914, not reappearing. El Monte, Upland and Laguna Canyon, **Johnston** in 1918. Native of Europe.

Solanum nigrum L. var. **villosum** L.

Rare and local. Los Angeles, **Davidson** in 1892, and **McClatchie** in 1896. Oxnard, **Davy** in 1901. Native of Europe.

Solanum rostratum Dunal. Buffalo-bur.

Naturalized near the coast in Los Angeles county. Salt works, "abundant," **Hasse** in 1884. Santa Monica, **Hasse** in 1891, and **J. H. Barker** in 1898. Casual at Mentone, **G. R. Robertson** in 1911. Local at Upland, **Johnston** in 1918. Infrequent in the state. Native from Florida to Arizona.

Physalis ixocarpa Brotero. Tomatillo.

An early immigrant, naturalized in gardens and orchards, less abundant now than formerly. It has been indicated as a native in this state,[52] but certainly erroneously, nor is there evidence that it ever was in cultivation. Native of Mexico.

Datura discolor Bernhardi.

Long established in the Colorado River bottoms, where frequent and possibly indigenous. Introduced and common along irrigation ditches in Imperial Valley; also in the streets of Mecca and adjacent mud flats, **Parish** in 1913. Native of Mexico.

Datura Stramonium L. Jimson-weed.

A local and temporary casual. Roadside at Santa Monica, "recently introduced," **Hasse** in 1893. Playa del Rey and Ballona, **Davidson** in 1896, "not seen recently" (1898). Native of Asia (?).

Datura Tatula L. Purple Thorn-apple.

Cultivated as an asthma remedy, in a garden at San Bernardino about 1870, escaping and still lingering as a rare weed in damp soils. Both these Daturas are infrequent and local in central California. Native of tropical America.

Lycium halmifolium Mill. Matrimony Vine.

An infrequent escape in streets, San Bernardino in 1910, 1919. The only other collection from the state seen is Beckwith, Sierra county, **Hall & Babcock** in 1903. Native of Europe.

Physalis Wrightii Gray.

Apparently native in the Colorado delta, whence abundantly introduced through irrigation in the Imperial Valley. Casual in an orange orchard, near San Bernardino, **Johnston** in 1918. Also in San Joaquin Valley, in orchards at Porterville and at Lemon Cove, **G. Surr** in 1920. In each instance only a single plant; otherwise not known in the state.

Nicotiana glauca Graham. Tree Tobacco.

Introduced from Mexico, in the mission period, perhaps as an ornamental shrub, and abundantly naturalized in waste places and cultivated grounds. In the Colorado Desert, a single young plant at Mecca, and two at Calexico, **Parish** in 1913. The most northern collection seen was from Santa Clara. Native of Argentina.

VERBENACEAE

Verbena officinalis L.

Infrequent and local. San Diego, **Cleveland** in 1884. Oneonta, San Diego county, **Chandler** in 1902. Riverside, **Reed** in 1917. Infrequent in the state. Native of Europe.

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[52]Rydberg. P. A. Mem. Torr. Bot. Club 14:334. 1896.

SCROPHULARIACEAE

Verbascum Thapsus L. Mullein.

Infrequent and local. Near Colton, an escape from cultivation, **Parish** in 1906. Riverside, **Reed** in 1918. Well established in parts of central California. The earliest record is Prairie City, a former mining camp in Sacramento county, **K. Brandegee** in 1854. Native of Europe.

Verbascum virgatum Stokes. Moth Mullein.

Long naturalized and frequent in dry soils from the neighborhood of Los Angeles to Claremont. Local in central California. Lake county, **Cleveland** in 1882. Sacramento river, **Baker & Nutting** in 1894. Native of Europe.

Linaria vulgaris Hill. Toadflax.

Upland, a few plants, **Johnston** in 1916. Local and rare in central California. The earliest collection seen was from Sonoma county, **K. Brandegee** in 1884. An abundant weed in the Atlantic states, where said to have first appeared as an escape from ornamental cultivation by a Mr. Ransted, a Welsh resident of Philadelphia.[53] Native of Europe.

Veronica arvensis L. Corn Speedwell.

Soldiers' Home, "adventive," **Hasse** in 1900. Riverside, **Reed** in 1907, and "increased and becoming frequent" in 1918. Infrequent in northern California. Native of Europe.

Veronica persica Poir. **V. Buxbaumii** Tenore. Bird's Eye.

Locally naturalized in lawns and gardens. Los Angeles, common, **Davidson** in 1896. San Bernardino, adventive and rare in 1901, now common. Redlands, **Greata** in 1907. Local in central and northern California. Native of Eurasia.

PLANTAGINACEAE

Plantago Coronopus L.

Santa Catalina island, **Davidson** in 1895, and in a desiccated pool at Pebble Beach, **Parish** in 1916. An abundant street weed at Pacific Grove, Monterey county, **Parish** in 1916. Native of Europe.

Plantago lanceolata L. Rib-grass.

A recent immigrant, now abundantly naturalized and common by roadsides, in lawns and waste grounds. San Bernardino, first seen in 1881 now abundant. Los Angeles, "struggling for a casual existence," **Davidson** in 1891. In the Colorado Desert, in a few lawns at El Centro, **Parish** in 1913. Evidently introduced earlier in the central parts of the state, **Hilgard** (1890)[54] considered it, "with **Setaria glauca,** the most formidable enemy of irrigated grounds and pastures in the foothills of the Sierra and more or less in the adjacent portions of the Sacramento valley," where, he states, the two overran and destroyed alfalfa fields. While it has become a troublesome weed in the south it is not so injurious as above indicated. Native of Eurasia.

Plantago major L. Plantain.

Long naturalized and common in meadows, gardens, lawns and by roadsides, in damp soils. Probably dates from the mission period. Common throughout the state. Native of Eurasia.

RUBIACEAE

Sherardia arvensis L. Field Madder.

An infrequent casual in lawns. San Bernardino, in 1913, not persisting. Los Angeles, **Davidson** in 1914. Native of Europe.

CAPRIFOLIACEAE

Lonicera japonica Thunb. Japanese Honeysuckle.

San Bernardino Valley, an occasional fugitive, and becoming naturalized, in damp thickets, **Parish** in 1910. Native of Japan.

DIPSACEAE

Dipsacus Fullonum L. Fuller's Teasel.

Locally naturalized. Cajon Valley, San Diego county, "well established," **Cleveland** in 1876, 1890. San Diego Mission, **Orcutt.** Los Angeles, **Lyon** in 1890, **Davidson** in 1893. A roadside weed in the Bay region. Native of Europe.

Scabiosa atropurpurea L.

Locally escaping from cultivation and persisting along streets. San Berdino, in 1890, 1916. Los Angeles, **Nevin** in 1904. San Diego, **Chandler** in 1902. More abundant in central California. Native of the Mediterranean region.

Scabiosa stellata L.

Altadena, along streets, **McClatchie** in 1893. Native of the Mediterranean region.

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[53] Darlington. W. American Weeds and Useful Plants. 2d Ed.
[54] Hilgard. E. W. Weeds of California, 249. 1891.

COMPOSITAE

Cichorium Intybus L.

A casual on streets. Santa Barbara, **Gray** in 1880. San Bernardino, **Parish** in 1895, 1914. Sherman, **Braunton** in 1902. San Diego, **Brandegee in** 1904. Riverside, **Reed** in 1905. Rialto, **Robertson** in 1906. Upland, **Johnston in** 1918. Not cultivated in our region. Native of Europe.

Picris echioides L. Bugloss.

Adventive in the coast towns of Los Angeles and Orange counties. Huntington Beach, **Condit** in 1909. Santa Monica, **Parish** in 1913. Dominguez Junction, **Moxley** in 1914. Mesmer, **Johnston** in 1917. Santa Ana, "a recent introduction," **A. J. Perkins** in 1919. San Bernardino, a very recent introduction, **Parish** in 1917. A common street weed in the Bay region. Native of Europe.

Tragopogon porrifolius L. Vegetable-oyster.

Naturalized and frequent in streets and waste places at Santa Monica, **Parish** in 1916, 1918. Los Angeles, **Davidson** in 1903. Native of the Mediterranean region.

Rhagadiolus Hedypnoides All.

Infrequent and local. Los Angeles, **T. W. Minthorn** in 1905. San Diego, **K. Brandegee** in 1906. More northern collections are: Mariposa, **Congdon in** 1895; Sonoma county, **Eastwood** in 1902. Native of Europe.

Hypochœris glabra L. Cat's ear.

Locally naturalized. Garvanza, **Grant** in 1904. Pasadena, **McClatchie**.. Redlands, **Greata** in 1905. San Diego, **Parish** in 1914. Red Hill, near Upland, **Johnston** in 1917. In the Monterey and San Francisco regions this species and the next are among the most common weeds, but their migration southward is recent. Native of Eurasia.

Hypochœris radicata L. Gosmore.

An abundant roadside weed at Santa Barbara, **Hall** in 1907, **Parish** in 1916. Native of Europe.

Taraxicum officinale L. Dandelion.

A recent immigrant, first appearing in lawns, now widely naturalized in towns, in damp soil by country roads, and invading meadows. Los Angeles, **Davidson,** first seen in 1891, and in 1893 still confined to "single plants in lawns." Pasadena, "occasional along streets," **McClatchie** in 1895. San Bernardino, a few plants in a single lawn, **Parish** in 1895. Upland, "still infrequent," and El Monte, "abundant, and injurious in pastures," **Johnston** in 1918. Native of Europe.

The introduction of this cosmopolitan weed into the state appears recent. The Botany of the Geological Survey was only able to report "some indications" of its presence in 1876. Hilgard[55] did not know it in 1890; in 1894 Greene[56] regarded it as "accidentally introduced and scarcely naturalized." It was still so rare a plant in 1898 that Davy[57] put on record two exact places where it could be found in Oakland; and in 1901 Jepson omitted it from his Flora of Western Middle California. It is now an abundant weed in the Bay region.

Crepis virens L. Hawksbeard.

Naturalized in the streets of Santa Barbara, **Parish** in 1916. Big Rock Creek, San Gabriel Mts., **Davidson** in 1896. Common in the Monterey and San Francisco regions. Native of Europe.

Sonchus arvensis L. Perennial Sowthistle.

Peat lands about Smeltzer and Wintersberg, Orange County, **R. K. Bishop** in 1913, already well established, and believed to have been introduced in celery seed about 1903; now naturalized and troublesome in that district. Not known elsewhere in the state. Native of Europe.

Sonchus asper L. Spiny Sowthistle.

Long naturalized and common in cultivated and waste, and occasional in unbroken, grounds. Ascends the San Bernardino Mts. to 6,500 ft., Bear Valley, **Parish** in 1895. Common in the cultivated parts of Salton Sink, Colorado Desert, **Parish** in 1913. Panamint Mts., Mojave Desert, **Coville & Funston** in 1891. Native of Europe.

Sonchus oleraceus L. Sowthistle.

Cismontane distribution of the preceding species, and somewhat more abundant. Common in the cultivated parts of Salton Sink. Native of Europe.

Sonchus tenerrimus L.

Locally naturalized at San Diego, doubtlessly from the mission period. Collected in 1836 by Nuttall, who regarded it as indigenous and published it as **S. tenuifolius.**[58] Specimens seen are all from Point Loma: **Cleveland** about 1886; **Orcutt** in 1894; **Purpus** in 1898. The only other Californian collections were from San Clemente, Santa Catalina and San Nicholas islands. Brandegee reports it as abundant on the islands off the coast of Lower California and on the mainland, appearing as if indigenous. Native of Europe.

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[55]Hilgard, E. W. Weeds of California. 247. 1891. "The place held in Europe and the East by the dandelion is measurably filled by several large-flowered species of Troximon and Hypochœris."

[56]Greene. E. L. Manual Botany Bay Region 227. 1894.

[57]Davy, J. B. Erythea 6:26. 1898.

[58]Nuttall, T. Trans. Am. Philos. Soc. 7:438. 1841.

Lactuca Scariola L. Prickly Lettuce.

Naturalized and common. Ontario, **Davidson** in 1911. San Bernardino, **Parish** in 1911, where the variety was already abundant. Upland, **Johnston** in 1917. Native of Europe.

Lactuca Scariola L. var. **integrata** Gren. & Godr. Prickly Lettuce.

Naturalized and common. Pasadena, **McClatchie** in 1895. San Bernardino, established in a few places, **Parish** in 1895. Compton, "quite troublesome in places," **Braunton** in 1896. Los Angeles, "two plants," **Davidson** in 1896, and in 1907, "one of the most troublesome weeds in the Los Angeles district, even invading the Black Mustard." Claremont, "rare," **Johnston** in 1918.

A very recent immigrant, but here, as elsewhere, its diffusion has been rapid. In some places the species first appeared, in others the variety, and even yet there are local differences in the abundance of either. The two are abundant weeds in cultivated grounds, gardens, roadsides and waste places, and in fields where there is sufficient moisture in the soil, but they do not make their way into unbroken dry hills and mesas. While obnoxious weeds these plants have not proved themselves so injurious in most parts of our region as they are reported to be elsewhere. The earliest records for the state are: Berkeley, "becoming established," **K. Brandegee** in 1890, and Sacramento, (the species), **Michner & Bioletti** in 1891. First reported in the United States from Cambridge, Mass., in 1835.[59] Native of Europe.

Cynara Scolymus L. Artichoke.

An occasional fugitive, long persisting, but usually not greatly spreading. Abundant over a hillside pasture near Rincon, San Diego county, **Parish** in 1897, and a few plants by a roadside at San Bernardino in 1899. Laguna, Murrieta, and Orange, **Johnston** in 1918. Native of Europe.

Centaurea Cyanus L. Corn-flower.

Los Angeles, "abundant at the racetrack," **Nevin** in 1904. An occasional escape throughout the state. Native of Europe.

Centaurea eriophora L.

Los Angeles, "observed for two seasons on North Avenue 50," **Davidson** in 1911. The only record for the state. Native of southern Europe.

Centaurea Melitensis L. Sand Bur.

An early introduction, probably of the mission period; thoroughly naturalized and abundant in fields and by roadsides; especially obnoxious as an aftermath in grain fields; mostly in light soils, but not confined to them; occasional in unbroken lands. In the Colorado Desert, at Palm Springs, **F. Gilman** in 1902. A common weed in most parts of the state. The earliest collection is **F. Guirardo** in 1861. Native of Europe.

Centaurea repens L.

A few scattering plants in 1919 in a field of sugar beets on the farm of Mr. A. Decker, at Artesia, Los Angeles county, 2-3 feet high, and seeding abundantly. It is already spreading in both cultivated and uncultivated ground, and proves difficult to eradicate by reason of its perennial rootstocks. Not elsewhere reported from the United States. Native of Eurasia.

Centaurea solstitialis L. St. Barnaby's Thistle.

San Diego, according to Gray,[60] but I have seen no specimens from that region. A few casuals at San Bernardino, **Parish** in 1907. Riverside, "adventive," **Reed** in 1918. A common weed in Sacramento valley. Native of the Orient.

Cnicus benedictus L. Blessed Thistle.

Casual in Los Angeles, "in two streets only," **Davidson** in 1918. Occasional in central California. Native of Europe.

Circium arvense L. Canada Thistle.

Locally well established in the peat lands about Wintersberg, Orange County, **R. K. Bishop** in 1917. Occasional in parts of northern California. The earliest report is Humboldt Bay, "well established," **Rattan** in 1879,[61] where it still persists, **J. P. Tracy** in 1916. San Francisco, **K. Brandegee** in 1892. Said to have first appeared in America about the French missions in Canada, and to have been carried thence to New York in hay used by Burgoyne's army in 1777.[62] In New Zealand it is miscalled "California Thistle.[63] Native of Europe.

Arctium Lappa L. Burdock.

Riverside, **Reed** about 1910, now somewhat increased. Occasional in a few places in central California. At the National Orange Show at San Bernardino in 1914 an advertising device, well adapted to disseminate this weed, was freely dis-

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[59]For an account of the spread of the Prickly Lettuce in the U. S. see Parish, S. B. In Muhlenb. 5:121. 1909.

[60]Gray, A. Synoptical Flora 1, pt. 2:406. 1884.

[61]Rattan, V. Cal. Horticulturist 9:335. 1879.

[62]Dewey, L. E. U. S. Dept. Agric. Div. Bot. Circular 27:5. 1900.

[63]Cockayne, L. Rept. Bot. Surv. Stewart Island 66. 1906.

tributed, consisting of a gaily colored paper butterfly, with a burdock bur for a body, by means of which it was made to adhere to the garments of passers, and was thus carried away. The same objectionable device was used in England and in New South Wales, until forbidden by law.[64] Native of Europe.

Silybum Marianum Gaertn. Milk Thistle.

Naturalized and widely distributed throughout the state, mostly by roadsides and in waste places, but sometimes invading pastures. San Bernardino, **Parish** rare in 1818, now much commoner, but not abundant. Chino Creek, near Ontario, "a serious pest in pastures," **Johnston** in 1918. The earliest collections are: San Francisco, **Behr,** "first appeared," in 1853; Prairie City, Sacramento County, "abundant," **K. Brandegee** in 1854; Knight's Ferry, **Bigelow** in 1857. Native of Europe.

Senecio sylvaticus L.

Infrequent and local. University Heights, San Diego, **K. Brandegee** in 1901. Jarupa hills, near Riverside, **Mrs. Wilder** in 1909. Native of Europe.

Senecio vulgaris L. Groundsel.

Locally common in yards and gardens, mostly near the coast. Los Angeles, **Davidson** in 1892. San Diego and Santa Barbara, **Parish** in 1916. Claremont region, **Johnston** in 1916, and in the San Antonio Mts., at Camp Baldy, 5,000 ft. alt. Common in central California. Native of Europe.

Artemisia biennis Willd. Annual Wormwood.

Infrequent in moist soil. Los Angeles, **Davidson** in 1890, and now more abundant. Cultivated field near Santa Ana, **Parish** in 1882. Santa Barbara, **Mrs. Cooper** about 1896. Mojave Desert, in a meadow at Victorville, **Parish** in 1915. Infrequent in the state. Native in the northwestern states.

Anthemis Cotula L. Mayweed.

A common roadside weed, but a recent migrant in the south from central California. San Bernardino, rare in 1880, now abundant. Santa Catalina island, "a recent introduction," **T. S. Brandegee** in 1890. Probably first introduced in the state in the pioneer period. Prairie City, Sacramento county, **K. Brandegee** in 1854.[65] Hilgard[66] first saw it by the roadside between Oakland and Berkeley in 1880, and reported it as "not yet widely diffused" in the Bay region in 1890. But as early as 1882 it had entered the coast regions, and in 1890 was abundant in hill pastures. It is now common throughout the state. Native of Europe.

Chrysanthemum coronarium L.

A recent introduction, naturalized along railway tracks and elsewhere in San Diego, **Mrs. Spencer** in 1919. Not otherwise known from the state. Native of the Mediterranean region.

Matricaria occidentalis Greene.

On a street, Highland, **Parish** in 1895, not reappearing. Thought to be native of the Sacramento valley.

Matricaria suaveolens Buchenau. **M. discoidea** DC. Pineapple-weed.

Widely distributed and abundant, but mostly about farms, old sheep corrals and in waste places, always appearing like an introduced plant. Adventive at a few places in Imperial valley, Colorado Desert, in 1913. In the Mojave Desert: Victorville, **Hall** in 1905. Pleasant Canon, **Hall & Chandler** in 1906. Cima, **K. Brandegee** in 1916. Lone Willow Springs, **Parish** in 1916. Native of the northwestern Pacific states.

Cotula australis Hook.

A weed of city streets; common near the coast, but seldom collected in the interior. San Diego, **Cleveland** in 1882. Los Angeles, **Minthorn** in 1905. Pasadena, **Grant** in 1905. Riverside, **Mrs. Wilder** in 1908. San Bernardino, in a lawn, **Parish** in 1911. Park at Ontario, **Johnston** in 1918. North to Humboldt county. Native of Australia.

Cotula coronopifolia L. Brass Buttons.

An early immigrant, probably of the pioneer period; common in spring on the borders of small streams and in wet places. In the Colorado Desert at the old Palm Springs Stage Station, on Carrizo Creek, **Parish** in 1915. Common throughout the state. Appeared first at San Francisco between 1851-1854.[67] Native of Europe.

Soliva sessilis R. & P.

Reported from "moist soil near Santa Barbara,"[68] but I have not been able to authenticate its present occurrence there. Infrequent in coast towns further north. Native of Chile.

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[64]Nature 84:547. 1910.
[65]Brandegee, K. Zoe 2:76. 1891.
[66]Hilgard, E. W. Weeds of California. 1890.
[67]Behr, H. H. Zoe 2:4. 1891.
[68]Gray, A. In Brewer & Watson, Bot. Cal. 1:406. 1876.

Galinsoga parviflora Cav.

Abundant along ditches, at Vernon, Los Angeles County, **Braunton** in 1902. Not otherwise reported from the state. Native of South America.

Hemizonia Fitchii Gray.

Quite abundant in a wheat field, Las Flores rancho, on the Mojave river in 1882. Native of central California.

Eclipta alba Hassk.

Naturalized in the bottom lands of the Colorado river ,thence waterborne to the Salton Sink, where it is common along ditches and in irrigated fields. Casual near Los Angeles, **T. W. Minthorn** in 1907. Native of tropical America.

Helianthus annuus L. Sunflower.

Long naturalized and common in cultivated grounds, notably as an aftermath in grain fields, where it often forms a dense, pure stand; frequent in unbroken soils, but not appearing indigenous. Rare in fields in Imperial Valley, **Parish** in 1913. In the Mojave Desert at an abandoned soda works at Soda Lake, and in the streets at Barstow and Victorville, in 1916. Common throughout the state. Native of North America.

Helianthus petiolaris Nutt.

Introduced, probably in foul grain seed, in fields at Harlem Springs, near San Bernardino, where it was abundant in 1910, but is now apparently extinct. Native from Minnesota to Arizona.

Verbesina australis Baker.

Oxnard, Ventura county, **Davy** in 1901. Native of Mexico.

Verbesina encelioides B. & H. var. **exauriculata** Robins. & Greenm. Crownbeard.

Naturalized, but infrequent; usually in or about grain fields. El Monte, **Parish** in 1882, and **Johnston** in 1918. Agua Mansa, near Colton, **Parish** in 1897. Cahuenga Pass, **Hall** in 1905. Native from Kansas to Texas.

Bidens frondosa L. Beggar's-ticks.

Locally adventive at Los Angeles, **Moxley** in 1916, and **Davidson** in 1917. Abundantly naturalized in the delta lands and islands of the lower Sacramento river. Native of the eastern states.

Bidens pilosa L. Bur Marigold.

An early immigrant, abundantly naturalized along ditches and on wet banks. In the Colorado Desert a single plant at Mecca, in 1913. Native of the West Indies and South America.

Melampodium perfoliatum HBK.

Probably introduced during the mission period, and long naturalized in waste places at Los Angeles. Not known elsewhere in the United States. Native of Mexico.

Xanthium italicum Mor.

Los Angeles, **Hasse,** the only California collection. Native of Italy.

Xanthium pennsylvanicum Wallr. Cocklebur.

A pernicious weed, long naturalized, and common in cultivated and waste lands, especially in lowland pastures. Common in the overflowed bottom lands of the Colorado River at Fort Yuma, **Parish** in 1913, thence waterborne to Salton Sink, where widely distributed in irrigated grounds, but not abundant. Common throughout the state. Native of the eastern United States.

Xanthium strumarium L. Cocklebur.

Colorado Desert, abundant in the overflowed bottom lands of the Colorado River at Fort Yuma, Parish in 1913.[69] Cameron Lake, **T. S. Brandegee.** Native of the eastern United States and Mexico.

Xanthium spinosum L. Spanish Needles.

Long naturalized and widely distributed, mostly by roadsides and in waste places, but seldom abundant, and no more so now than 35 years ago. Throughout the state. Native of Europe.

Bellis perennis L. English Daisy.

Often planted in lawns, where it multiplies rapidly, and occasionally escapes. Los Angeles, **Davidson** in 1892. In the Humboldt Bay region it is said to be "firmly established everywhere," **Chandler** in 1901. Native of Europe.

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[69]Doubtfully referred to **X. chinensis** Mill. by Millsp. & Sherff in Field Mus. Nat. Hist. Publ. 204:19. 1919. Our cockleburs are too seldom collected and too little studied to permit their distribution to be properly defined. They are unhappily abundant, and always have the appearance of introduced weeds.

Erigeron bonariensis L. E. linifolius Willd.

A recent immigrant, now widely naturalized and abundant in cultivated and waste grounds. Santa Barbara, **Mrs. Cooper** before 1896.[70] Redlands, **Greata,** and Riverside, **Reed** in 1905. Pasadena, **Grinnell,** and San Bernardino, **Parish** in 1906. Colton, **Mrs. Wilder** in 1907. The earliest record is: Bakersfield, **Miss Eastwood** in 1893. Common street weed in the Bay Region, **Parish** in 1917. Native of South America.

Erigeron canadensis L. Horse-weed.

Widely naturalized in cultivated and waste grounds, probably an early immigrant. Along the river banks, Victorville, Mojave Desert, in 1916. A common weed in cultivated grounds in the Colorado Desert, in 1913. Throughout the state. Native of the eastern states.

Trichocoronis Wrightii Gray.

In a marsh near Beaumont, **Hasse** in 1911. Also in the Delta lands of the Sacramento River. Native of Mexico and Texas.

Eupatorium album L.

A casual on the banks of a pond, south of Pasadena, **McClatchie** in 1896. Native of the Atlantic states.

ZAUSCHNERIA ORBICULATA n. sp.

GEORGE L. MOXLEY

Plant about 2 dm. or less in height, decumbent or ascending, sparsely short white hairy, leafy; cauline leaves opposite, orbicular or rarely somewhat obovate, rather coarsely callous-denticulate, emarginate to abruptly short-mucronate, the largest about 15 mm. in diameter; floral leaves orbicular shell-like bracts 3 to 5 mm. in diameter; calyx tubular, 14 to 16 mm. long, its laciniae 5 mm. long, minutely puberulent, the tips slightly divergent in bud; petals about 8 mm. long, narrow, with a deep sinus; stamens barely exserted; style exserted 5 to 8 mm.; ovary 5 to 7 mm. long, minutely glandular; capsule about 15 mm. long, fusiform, short-pedicellate or subsessile, long beaked.

Saw Mill Canyon, eastern slope of the Sierra Nevada, in loose lava at 7500 ft. altitude, Aug. 28, 1919. Collected by Frank W. Peirson, no. 759. Type in author's herbarium. Duplicates in herb. Frank W. Peirson, Pasadena, Calif.; Dudley Herbarium, Stanford University; California Academy of Sciences; U. S. National Herbarium; Gray Herbarium.

This is a plant of very striking appearance and quite distinct from any form I have yet seen. The orbicular, sometimes obcordate and somewhat emarginate leaves serve to distinguish it at once from any other Zauschneria. It is of the tubular small-flowered type, resembling to some extent, in its floral characters *Z. glandulosa*, *Z. Hallii* and *Z. pulchella,* and in the foliar characters somewhat approaching *Z. elegans* Eastw.

NOTE.

The Botanical Records and the author of *Allium montigenum* was omitted in the last issue. Both are to be credited to Dr. A. Davidson.

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[70] Eastwood, A. Erythea 4:99. 1896.

BULLETIN OF THE

Southern California Academy of Sciences

INDEX

Volume XX, Part 1
April, 1921

COMMITTEE ON PUBLICATION
WILLIAM A. SPALDING
ANSTRUTHER DAVIDSON, C. M., M. C.
DR. JOHN A. COMSTOCK

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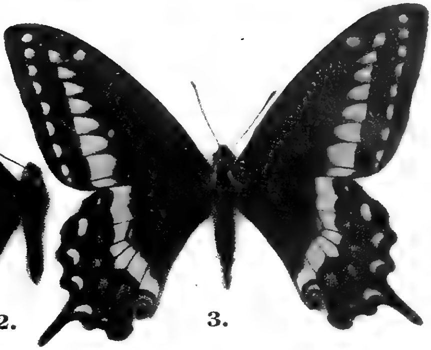
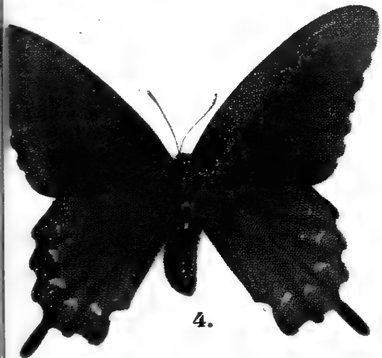
1\. EDWARD'S SWALLOWTAIL (*P. indra pergamus*) ♂

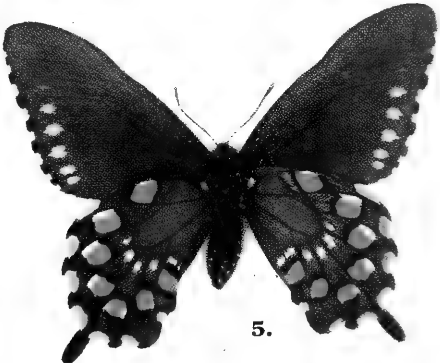
2\. EDWARD'S SWALLOWTAIL Under side. ♂



3\. EDWARD'S SWALLOWTAIL (*P. indra pergamus*) ♀



4\. The PIPE-VINE SWALLOWTAIL (*Papilio philenor*) ♂



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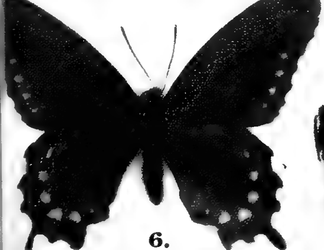
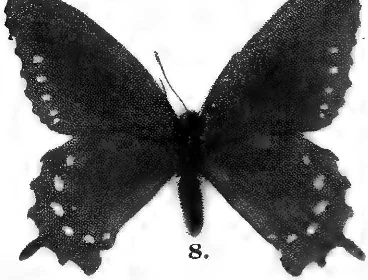


6\. The HAIRY SWALLOWTAIL (*P. philenor hirsuta*) ♂

7\. The HAIRY SWALLOWTAIL Under side. ♀



8\. The HAIRY SWALLOWTAIL (*P. philenor hirsuta*) ♀

The SWALLOWTAILS

Ab t ⅔ Natural Size

Butterflies of California

THE SWALLOWTAILS AND ALLIES.

Dr. John A. Comstock

(Family, The Papilionidae, Sub-family, The Papilioninae)
The Swallowtails. (Genus Papilio, Linnaeus)

THE PIPE LINE SWALLOWTAIL. (Papilio philenor, Linn.)
Plate II, Fig. 4, male; Fig. 5, female, under side.
Syn. astinous, Dru.

THE HAIRY SWALLOWTAIL. (P. philenor hirsuta, Skin.)
Plate II, Fig. 6, male; Figs. 7 and 8, females.

THE PIPE VINE SWALLOWTAIL and its first cousin, the HAIRY SWALLOWTAIL (P. hirsuta, Skin.) are to be found in the Northern part of the state, being particularly plentiful in the region North of the San Francisco Bay. They have been occasionally reported from points as far south as San Diego. The California form is the variety named by Skinner and distinguished by its shorter tails and hairy body.

Most of the Southern California captures seem to be the typical form and are probably introduced from the eastern states on *Aristolochiae,* which is occasionally used as a porch-shading vine.

BAIRD'S SWALLOWTAIL. (Papilio, bairdi, Edw.)
Plate III, Fig. 1, male; Fig. 2, female.
Syn. utahensis, Stkr.

BAIRD'S SWALLOWTAIL is an extremely rare capture in California. It has been authentically reported only from the central Sierras to the San Bernardino Mountains. July is its favored month. The larvae feed on umbelliferous plants.

THE ANISE SWALLOWTAIL. (Papilio zelicaon, Luc.)
Plate III, Fig. 3, male; Figs. 4 and 5, females.
Syn. zolicaon, Bdv.
Syn. californica, Men.
Syn. coloro, Wright.

THE ANISE SWALLOWTAIL is common throughout the state, specimens being taken from February to November. It is most abundant in the lowlands about townsites where its favorite foodplant (Carum kelloggii, wild anise) occurs. The larvae feed on a wide variety of umbelliferous plants. They are also occasionally found on Citrus, but have never become a serious pest in the orange groves.

THE SHORT-TAILED SWALLOWTAIL. (Papilio indra, Reak.)

Plate III, Figs. 6 and 7, males; Fig. 8, female.

EDWARD'S SWALLOWTAIL. (P. indra pergamus, Hy. Edw.)

Plate II, Figs. 1 and 2, males; Fig. 3, female.

This species occurs in two forms, the northern race or *Short-Tailed Swallowtail*, which is taken in the high Sierras of northern to central California, and the southern race, *Edward's Swallowtail* which flies in the southern Sierras. Both varieties are considered highly desirable from the collector's standpoint, the southern race particularly being counted as a great prize. *Edward's Swallowtail* has been captured as early as April, while in the higher Sierras the species does not emerge until June or July. The larvae feed on umbelliferous plants.

THE WESTERN TIGER SWALLOWTAIL. (Papilio rutulus, Luc.)

Plate IV, Figs. 6 and 8, males; Fig. 7, female.

THE WESTERN TIGER SWALLOWTAIL is our most common Papilio occurring throughout the entire state, and flying from early spring to late summer. The larvae choose a wide variety of foodplants, including poplar, alder, hop and willow. An alpine form has been distinguished by Behrens, which he has called *ammoni*. It differs principally in the darker shade of yellow forming the ground color of the wings.

(To be continued)

(Plate IV will appear in the next issue of the BULLETIN.)

FEDERATION AERONAUTIQUE INTERNATIONALE

AERO CLUB OF AMERICA

No. 913.

The above-named Club, recognized by the Federation Aeronautique Internationale, as the governing authority for the United States of America, certifies that

Dr. Ford A. Carpenter

born 25 day of March 1868 having fulfilled all the conditions required by the Federation Aeronautique Internationale, is hereby licensed as Spherical Balloon Pilot

Dated February 23rd, 1921.

Myron T. Herrick
President.

Augustus Post
Secretary.

[SEAL]

Signature of Licensee:

Ford A. Carpenter

"The Civil, Naval and Military Authorities, including the Police, are respectfully requested to aid and assist the holder of this Certificate."

"Les agents de la force publique, les autorités civiles et militaires, sont priés de vouloir prêter aide et assistance au titulaire du présent titre."

"Die Civil- und Militärbehörden werden gebeten, dem inhaber dieses Zeugnisses Schutz und Hülfe zu gewähren."

"Gli agenti della forza publica e le autorità civil e militari sono pregati di voler dare aiuto ed assistenza al titolare del presente libretto."

"Se ruega á las autidoridates tanto civiles como militares, se sirvan prestar su ayuda y asistencia al portador del presente titulo."

«Покорнѣйше просятъ Г.г. представителей военной, гражданской и полицейской властей оказать возможную помощь и содѣйствіе лицу, предъявившему настоящее свидѣтельство.»

INTERNATIONAL AERONAUT'S CERTIFICATE

The holder of the certificate passed the following flight tests as Spherical Balloon Pilot of the Fédération Aéronautique Internationale. *A,* 10 ascensions without any conditions, 1919, 1920, 1921. *B,* Ascension of one hour's minimum duration, undertaken by the pilot alone, Feb. 12, 1921. *C,* Night ascension between setting and rising of sun, Aug. 26, 1919, 11 hrs, 58 mins. Making, inflation, deflation and prescribed tests were made under direction of the United States Army Air Service, Ross Field, Arcadia, California.

A SOLO FLIGHT IN A SPHERICAL BALLOON

By Dr. Ford A. Carpenter.

Illustrated by photographs made by the author during the journey

❋ ❋ ❋

The 913th solo spherical balloon flight of the Fédération Aéronautique Internationale was made on February 12, 1921. The free balloon flight in this instance was conducted by the Air Service Balloon School of the United States Army at Ross Field, Arcadia, California.

In itself, the occasion being a pilot qualification test, was not an unusual one, but many of the attendant circumstances surrounded the event with more than the obvious importance to the individual. First, the flight was made by a Consulting Meteorologist under the Army rules and in aircraft of the United States. Second, the flight was practically an "economy run" breaking all previous records (so balloonists stated) for the combination of minimum amounts of the four elements: gas, ballast, distance, and altitude. There was the smallest quantity of gas as well as ballast used, combined with both the short distance traveled and the low level maintained as shown by the mean and maximum altitude. Third, it was the satisfactory working out of a theory that no where exists more dependable atmospheric conditions for the control of a balloon than in Southern California. For over one hundred years in France where ballooning is popular, it has been considered a feat if the veteran balloon pilots sailed their balloons at a low level with the least amount of ballast and the most infrequent diminution of the gas supply; this, the aeronauts considered, evidenced the skill of the pilot in taking advantage of the principal weather elements such as wind and temperature.

Before giving a narrative of the solo balloon flight, it may be worth while to consider a few preliminaries such as a comparison of the balloon and the airplane, the construction, equipment, and the navigation of a balloon.

Balloons and Airplanes Compared—To the majority of people a balloon *flight* is an anomaly, for have they not seen balloon ascensions where the circus performer rises in a hot-air balloon and descends in a parachute, or have they not known a few venturesome people who have ascended in a captive balloon? A balloon flight is, however, a reality; it is claimed by aeronauts to be the "joy-riding of the air". Historically, it was the first means of mechanical suspension and flight ever tried and remains today, after one hundred and thirty-seven years since Rozier (1), who

1. Douglass Archibald. The Earth's Atmosphere. London, 1915.

was the first man to ascend in a balloon, the most esthetic means of aerial navigation. A comparison between the balloon and the airplane would be like matching a sail-boat with a motor-boat. The former depends entirely upon the winds and the latter, while accelerated or retarded by air-currents, has a speed so great as to be practically independent of them. The sail-boat and the balloon are free from vibration and both require their pilots to be well versed in weather-lore. The airplane and the motor-boat are heavily powered and they are always trembling with the vibration of their motors. Aside from storm winds, both airplane and motor-boat may, and ofttimes do, dispense with all but rudimentary knowledge of meteorology as a science. The comparison must not be carried too far, or else it would be necessary to make another similie not so palatable to the navigators of the heavier-than-air craft and admit that unlike the motor-boat, the airplane will sink if the engine stops. Safety appliances, such as parachutes never form part of the equipment of a free-flying balloon for the reason that the balloon itself acts like a parachute in case of an accident in mid-air.

Construction of a Balloon—Although the balloon is the oldest means of aerial navigation, antedating the airplane by more than a century, very little is popularly known of the equipment and management of the modern spherical free-flying balloon. It may be well, therefore, to briefly describe the balloon. First and most important of all, is the gas-bag which may have a capacity of from 9,000 cubic feet up to 100,000 cubic feet. It is inflated with hydrogen gas or coal-gas. The former is used exclusively by the military establishments owing to its greater lifting power and the consequent quickness of response of the balloon. The 9,000 cu. ft. balloon is a one-man affair while the 100,000 cu. ft. bag will carry half a dozen persons and half a ton of ballast and transport them for long distances. The 12,000 cu. ft. balloon is the one most commonly used for solo work as it permits of several hundred pounds of ballast being carried in addition to the pilot, his instruments, supplies, etc. For general use, however, the 35,000 cu. ft. balloon is the most popular size because the ample carrying capacity allows a complete equipment with generous ballast in addition to the pilot and three passengers. The material of which the gas-bag is made is of rubberized fabric which is very light but of strong construction, the smaller balloons weighing but a few hundred pounds. The pilot always has to remember that the bag is a mass of light gas which is being continually pushed upward by the heavier surrounding gases of the atmosphere. The envelope is simply a thin partition which separates the gases and does not expand and contract like the small pure gum balloons. The gas-bag terminates in a long funnel-like tube which is aptly called the "appendix". This is left

open when flying so that equilibrium of pressure may be maintained with safety.

Surrounding the bag is a net of cotton cords terminating in the "concentration-ring" from which is suspended the basket. The baskets are of wicker and naturally everything but safety is sacrificed to lightness of construction. Terminating within the concentration-ring are the two important controls: the valve-cord which runs through the center of the bag to the aluminum valve at the top of the bag, and the rip-cord which is fastened to a panel in the bag. The location of the rip-panel may be seen in the accompanying photograph (Fig. 1.) The former regulates the amount of gas discharged and the latter is an emergency measure used only when about to land in a heavy wind. The valve-cord is a light linen cord, the ends of which are held in a small cotton bag, and the rip-cord is a flat linen tape, colored red. The shape and color of the rip cord is to prevent its being mistaken for the valve-cord.

Equipment of a Balloon—Within the basket are a number of 15-lb. bags of sifted sand, a pouch at the side of the basket containing loose sand, and a small scoop. In addition to the instruments carried (statoscope, altimeter, barographs, and thermometers) is a supply of several hundred sheets of tissue paper which are used to determine whether or not the balloon is rising or falling. If a tissue sheet falls, the balloon is rising; if it rises, the balloon is descending. It is not possible to tell by the eye or other sensation whether one is rising or falling as there is no sensation except that of motionless suspension.

The statoscope, altimeter, and barographs are instruments showing the rate of ascent or descent, and, in the case of the barograph an ink record is made of every portion of the journey. As the mass of gas in the balloon is very susceptible to heat and cold, a delicate thermometer, or better yet, a finely adjusted thermograph, is necessary to anticipate temperature changes.

On the outside of the basket are hung canvas water bottles, life preservers, and a heavy anchor attached to about a hundred feet of rope. In addition to the preserved food carried within the basket, the supply of water is essential in this region because of the proximity of the desert and the life preservers for the like proximity to the sea. The anchor is used to retard flight when about to make a landing and not to hold the balloon. The most useful apparatus is the drag-rope which is a 300-ft. ¾-inch rope, made into a ball and suspended from the side of the basket. The fastenings of the drag-rope are cut just when it is decided to make a landing. The rope trails on the ground, relieving the balloon of that much weight, and by means of this rope the balloon may be pulled down by people below as it may sometimes happen.

There are also necessary tools within the basket such as a heavy knife for emergency use, and a saw in case the balloon runs afoul of a tree in landing.

The Navigation of a Balloon—A balloon, like a sail-boat, is at the mercy of the wind. Unlike a sail-boat it floats within the current of air and there is no sense of motion. Upon the skilfulness of the pilot in ascending or descending into air currents of different directions depends successful navigation. He ascends by releasing ballast and descends by releasing gas from the bag. Winds do not blow with like directions at all levels as will be seen from the following table of wind directions and velocities from observations at the U. S. Army Balloon School at Ross Field on a typical morning:

UPPER AIR DATA FROM U. S. ARMY BALLOON SCHOOL, ARCADIA, CAL., FEB. 15, 1921 (2).

Altitude (feet)	Surface	250	500	750	1000	1500	2000	2500	3000	4000	5000	6000	7000	8000
Wind Dir.	SW	SE	E	E	E	SE	SE	E	E	N	NW	NW	NW	NW
Wind Velocity (miles per hour)	3	4	5	6	8	11	12	12	12	6	16	35	46	64

It will be observed from a perusal of this table that the wind changes in direction and velocity for every level from the surface where the wind is light and from the southwest, 250 feet higher where the wind backed to the southeast, and to 1000 feet altitude where the wind blows from the east with increasing velocity. At 1500 and 2000 feet above the earth a southeast wind is again experienced but of 12 miles per hour, which velocity is held 1000 feet higher. At 4000 feet altitude the wind is blowing lightly from the north, indicating a transitional region comparable to the "Back-water" of the tides. Although the wind blows steadily from the northwest from 5000 feet up to 8000 feet. The velocity increases proportionately to the distance above the earth's surface, it being 16 miles per hour at 5,000 feet and 64 miles per hour at 8,000 feet. To the balloonist, it means that if he wished that morning to fly from Los Angeles to the San Fernando Valley, he must keep his balloon below the 3000 ft. level. If, however, he desires to fly to San Diego, he would throw out sufficient ballast to enable him to reach the five- to eight-thousand foot level at which latter elevation he would travel to San Diego in about two hours' time. If the balloonist wished to go in an opposite direction, he would keep close to the surface and his progress would be very slow. The movement of the wind in the air levels above the earth is not always the same, but varies with the dis-

2. U. S. Weather Bureau Daily Weather Map. Los Angeles, 1921.

Fig. 1

A TWELVE THOUSAND CU. FT. SOLO BALLOON

8:10 A.M. FEB. 12, 1921, ELEV. 500 FT. ABOVE SEA LEVEL.
CAMERA FACED NORTHWEST.

This balloon had made but two previous ascensions; the present being the third for the balloon and the two hundred and ninth for Ross Field. The pilot of the present flight also made the first trip (as meteorologist) in June, 1919, from this Field. The records of the War Department state that this was the first military spherical balloon flight made on the Pacific coast.

tribution of the great storm and fair weather eddies in the atmosphere. In southern California, owing to the frequent occurrence of purely local control of the wind by the land and water areas and the irregular topography, it is possible to map out regular courses which balloonists will take. Such "air-lanes" have been known for many years (3.) The writer has frequently been in a company of balloons where his craft was flying rapidly in one direction and his companions, in other levels, were traversing space with the same speed but in opposite directions.

It is apparent that the aeronaut must know local weather conditions in order to govern his balloon safely and efficiently. One of the most spectacular illustrations of the application of local meteorological phenomena is exhibited not infrequently at the Naval Air Station at San Diego. While the writer was visiting that station recently in his official capacity as a Lieutenant, U.S.N.R.F. cl. 6, he learned of the practice of the naval balloon pilots there to take advantage of the land-and-sea-breeze. The pilot would ballast heavily, and, ascending rapidly into the offshore breeze, drift over the sea, pull the valve-cord when out a few miles, descend within a few hundred feet of the ocean, into the on-shore wind, and land at the station where they started. by thus utilizing the upper flowing land-breeze they would fly westward, and descending into the lower, easterly flowing, seabreeze, it would bring them back to their place of ascension.

General knowledge of meteorology as well as intimate acquaintance with local features is therefore of prime importance to a balloon pilot. He should be a meteorologist as well as a balloonist. Expert meteorological ability enabled Lt.-Col. H. P. Hersey (now in charge of the U. S. Weather Bureau office at Los Angeles) in company with Col. Frank Lahm, to be of the greatest assistance in winning the Gordon-Bennett trophy in the first international balloon race from Paris in 1906 (4).

American aeronauts, from Hersey to Upson, have always excited considerable admiration from European pilots by their technical knowledge of weather and their personal bravery in the face of adverse conditions. As to the safety of balloon flying, aeronautic authorities agree that there is no sport providing more adventure and exhilaration in such small proportion to the danger from accidents than ballooning. Two or three years ago the Goodyear Co. in training overseas pilots made 3,200 spherical balloon flights carrying 10,000 persons and traveled more than 60,000 miles without a single accident (5). Until two years ago the altitude record for manned aircraft was held by a balloonist, Dr. Berson, who ascended 6½ miles. The present record of nearly

3. Ford A. Carpenter. Climate and Weather of San Diego. Harrisburg, 1913.
4. H. B. Hersey. Experiences in the Sky. Century Magazine, 1906.
5. R. H. Upson. Free Ballooning. Akron, 1919.

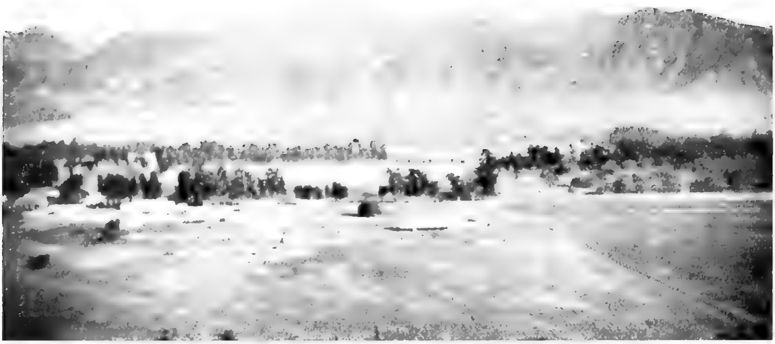


Fig. 2

PORTION OF THE BALDWIN RANCH, SIERRA MADRE AND THE SAN GABRIEL RANGE

8:40 A.M. FEB. 12, 1921, ELEV. ABOVE GROUND 250 FEET. CAMERA FACED NORTHWEST.

This Photograph was made while the balloon was drifting in a westerly direction just over the Foothill boulevard. The cold air, sliding down the numerous canyons, was made visible in the form of vapor. The Mount Wilson Observatory domes and towers are almost indistinguishable, they are to the east of the highest part of the sky-line.

7 miles is held by Aviator Schroeder. The maximum altitude of over 20 miles was made in southern California by balloons carrying meteorological instruments. Mr. W. R. Gregg in referring to the highest aerial sounding recently stated, "............if the Pavia record is to be deprived of that distinction so far as known, the next highest observation published is that made at Avalon, Calif., on July 30, 1913. As computed from the barograph trace, an altitude of 32,640 meters [108,000 ft. or 20.4 miles] was reached. The pressure was 7.4 millimeters. The rate of ascent was about 100 meters per minute near the surface, 275 at 16 kilometers, and 520 at the highest altitudes" (6).

The Solo-flight—It cannot be denied that the solo-flight, which is the last stage of balloon-schooling before receiving a diploma, is generally faced with some apprehension. But on the morning of Lincoln's birthday, the sunshine was bright, the sky free from clouds, the air motionless and of such moderate temperature, and above all the beautifully modeled new balloon gently swaying above its new basket, all elements combined to dispel every thought of worry as to the outcome. With a background of experience obtained by a record of twenty-five flights, forty air hours, and twelve hundred miles of flying in every kind of aircraft, the novice for the first time assumed actual command of a balloon. Surrounded by his officer and student friends, the pilot felt a pardonable elation as he inspected the valve-cord, rip-cord, statoscope, drag-rope, life-preservers, water and food supply. The orderly array of sandbags felt good under his feet as he arranged the barographs, thermograph, camera, field-glasses, megaphone, etc. As an anchor is rarely used in this region, he took in its stead a few extra bags of ballast. But before climbing into the basket and assuming command, the pilot realized that he had to decide between taking this exquisitely made little balloon with its splendid equipment (which was good for 24 hours' journey over desert, mountains, or sea) and make an altitude or long-distance flight, beating his own record of 10,000 feet, or as the other alternative, making a new hour's qualification record for low altitude, minimum ballast and gas consumption. As four officers were also named in his official orders for the flight to take the balloon when he had done with it, and accomplish their own solo qualifications, he resolved, before leaving the ground, to make the flight a record-breaker in minimum altitude and distance and low consumption of sand and gas. As a passenger, recorder, observer, or meteorologist on nine previous flights he had always closely observed and carefully analyzed every action of the pilot. For these studies a five-minute log of the course was kept. These entries showed the altitude, wind direction and movement, character of the ground and navigation of the ship, as well as com-

6. R. J. Gregg. Monthly Weather Review. Washington, Nov., 1920.

Fig. 3

SHADOW OF THE BALLOON ON AN ALFALFA FIELD

9:02 A.M. FEB. 12, 1921, ELEVATION ABOVE GROUND, 250 FT.
CAMERA FACED NORTH.

The shadow shows the balloon, basket and flag. By means of the shadow it was possible to estimate quite accurately the speed of the balloon and the direction of the movement.

plete meteorological and navigation notes which would aid in air-charting (7). As the temperature was slowly rising and consequently giving increasing buoyancy to the balloon, it was only necessary to wait a few minutes after he had given the order "All hands off!" to rise without further sacrifice of ballast. With so small a balloon, filled with pure hydrogen gas it requires only a small handful of sand to gain altitude. The management of such a craft inclines one to the belief that the French aeronauts were well within the facts when it is said that they measured the ballast with a thimble. The difference between a hydrogen filled balloon and a coal gas balloon is the difference between riding a thoroughbred or a plow horse. As the balloon imperceptibly rose foot by foot, the pilot looked over the side of the basket and saw the group of officers and men who but lately had had hold of the basket, and a feeling of elation possessed him. There is always a singularly venturesome feeling which enters into almost every balloonist's soul as he leaves the earth. Experience intensifies this feeling which accounts, doubtless, for some of the extraordinarily hazardous actions of aeronauts.

Seated comfortably in a wicker chair which formed part of the de-luxe equipment, the pilot looked out across the beautiful Sierra Madre district and the broad acres of the "Lucky" Baldwin estate to the purple rampart of the San Gabriel mountains only a couple of miles distant. The down-rush of cold air from their serrated sides was already being made visible by the thin silvery mists along their base (See Fig. 2). Experience had long told him that one of the best visual methods of estimating both altitude and drift was the shadow of the balloon on the ground. The air was so pure, the sun so bright that the balloon shadow permitted nearly exact determination of the direction and speed of the balloon (See Fig. 3).

It was extraordinarily interesting to watch the extreme sensitiveness of the balloon's response to changing temperature as produced in traversing different character of terrain. This was the writer's experience in early airplane flights half a dozen years ago. Although the barograph record of the flight showed an average altitude of 230 feet during the 62 minutes, with a minimum of 150 feet and a maximum of 260 feet elevation above the ground, changes of less than 10 feet in altitude (not readily shown by statoscope or altimeter) were constantly taking place owing to the different absorption and reflection surfaces below. The balloon fell as it left the parade ground of Ross Field and traversed an alfalfa patch with its cool air necessitating throwing

7. Ford A. Carpenter. Journey Through the Landscape of the Sky. Scientific American Monthly, 1920; also, Charting Air-Lanes, Los Angeles to San Diego. Bull. Am. Metlg. Soc., 1920.
8. Ford A. Carpenter. The Aviator and the Weather Bureau. Harrisburg, 1916.

Fig. 4

THE BALLOON OVER A CALIFORNIA BUNGALOW NEAR LAMANDA PARK

9:15 A.M. FEB. 12, 1921, ELEVATION ABOVE GROUND, 225 FT.
CAMERA FACED NORTH.

The orange and lemon groves have the texture of deep green velvet as seen from the air, and the deciduous orchards, shown in the upper part of the picture, look leafless in comparison. As the balloon passed over the reservoir (shown in the left of the photograph) the balloon decreased its altitude by the fall in temperature and 1 lb. of sand had to be thrown overboard to bring the balloon back to stable equilibrium.

out a small scoopful of sand. Even the warmer air over the asphalt highway gave expansion sufficient to elevate the balloon nearly 50 feet. The temperature was steadily rising and the speed was less than two miles per hour.

The shadow of the balloon was excellent company; not only was the black sphere projected in silhouette but the flag, the basket, with its attachments and the profile of the pilot as well, following along the ground (See Fig. 3). About this time the course was plotted on the map and also visually, and a landing spot selected. This was an easy matter for the distance and direction to be traversed in the 18 or 20 minutes remaining in the hour's test could be readily forecast, and it was only necessary to look out for a plot of ground free from high-tension or other overhead wires, troublesome trees, home gardens, or cultivated ground. The landing place having been decided upon, the pilot settled down to a complete enjoyment of the trip.

Drifting over a charming bungalow (See Fig. 4) one of the inmates saw the shadow pass over her as she was watering the lawn, and looking up at the solitary individual in the balloon, asked him if he was not lonely up there and didn't he want company? Replying that nothing would suit him better, "But", he facetiously added, "You see, I'm on my way to San Francisco for a luncheon engagement and I cannot stop to take you on."

Such is the extreme stillness of the air in balloon flight that sounds can be heard for long distances. I have found by experience that a man's shout may be heard at 1,500 feet altitude, a cock's crow at 5,000 feet, the barking of a dog a thousand feet higher, and the noise of a train at 8,500 feet. In night flights the sounds of the woodfolk scurrying along their trails in the brush the drowsy chirping of the birds in the trees below, and the shrill cries of the bats are all most interesting and lend enchantment to the mysterious darkness into which the balloon is drifting. In daylight flights during a gale, ofttimes the only indication that the balloonist has of the storm is the swaying of the trees as shown by his field glasses, and, as he nears the ground, the sound of wind in the trees or the whistling of the wind through the brush or cornfields.

It doubtless is the experience of every balloonist, but the pilot in the present instance certainly felt a keen regret that his flight was about over. Reaching up he gave the valve-cord a one and one-half second pull, and immediately followed this movement by throwing out four and one-half pounds of sand and cutting the drag-rope. The little balloon responded instantly to the gas emission by falling, but the descent was checked by the release of ballast, and the drag-rope retarded its forward motion. The land-

ing was made so slowly that if a glass of water had been left standing on the floor of the basket, not a drop would have been spilled. In a moment four or five officers rushed up and the senior major exclaimed most generously "Congratulations! We all knew you could do the trick if given an opportunity and feel proud to number you as one of the fraternity of spherical balloon pilots."

The following is a copy of the official account of the journey:

War Department
Air Service
Form No. 109

WAR DEPARTMENT
AIR SERVICE
F R E E B A L L O O N L O G S H E E T
Station, Ross Field, Arcadia, California.

	Weights (Lbs.)
Date, 12 February, 1921.	
Pilot, Dr. Ford A. Carpenter........	159
Aide and Recorder..................	..
Asst. Pilot	..
Passenger	..
Passenger	..
Passenger	..
Passenger	..
Ballast (No. of bags) 10...........	150
Balloon and supplies................	..
Instruments	6
Total weight	.. -
Balloon shipped by.................	..
From	
Barometric pressure (Start)........	29.47
Number pigeons carried............	0

Volume of gas in balloon (start) 12,000 cu. ft.
Quality of gas 100 per cent pure.

Solo Flight No. 209.
Balloon No.....Capacity 12,000 cu. ft.
Starting point, Ross Field, Time, 8:20 a.m.
Remarks—Auth. Personnel.
Memorandum No. 23, dated Ross Field, Feb. 11, 1921, First Solo Flight, Pilot: Dr. Ford A. Carpenter.
Landing point 2 mi. SE Lamanda Park—Time 9:22 a.m.
Remarks—Inflation started before 7 a.m. Feb. 12, 1921. Flight duration 1 hour 2 mins. Distance 2½ miles. Ballast at landing 142½ lbs. (9½ bags.) Altitude above sea level: Starting point, 500 ft.; landing point, 500 ft.

Time	Altitude (ft.)	Direction of flight	Temperature (Deg. F.)	Valved (Secs.)	Ballast dropped (lbs.)	R E M A R K S: (As topography passed over, type of clouds, speed of travel, names of physical features, etc.)
8 20 a.m.	Off					
25	150	West	62°		1	Over Ross Field Parade Ground
30	200	"	64°			Over alfalfa field speed 2 m. p. h.
35	250	"	68°			Paralleling P. E. tracks (expansion)
40	250	"	70°			Hailed by Capt. Weeks A. S. from highway
45	260	"	72°			Coat off; speed 1 m. p. h.
50	250	"	72°			Odor of violets from field below
55	250	"	68°			Cool air from S; 1½ m. p. h. speed
9 00	250	"	70°			Crossed P. E. tracks; speed 1½ m. p. h.
5	250	"	70°			Speed 1 m. p. h.
10	225	"	70°			Speed 2 m. p. h.
15	230	"	72°		1	Speed 3 m. p. h.
20	200	"	74°	1½	4½	Cut drag-rope
22	Landed					

Summary of Important Incidents: Two barographs (Richards) were carried during flight; No. 799, reading to 5,000 ft. and No. 499, reading to 15,000 ft. both time interval 10 mins. dots each minute. Ten photographs made during flight.

(Signature of Recorder)

A TRUE COPY:

Ford A. Carpenter

(Sigd.) C. M. SAVAGE, Capt. A. S.
Adjutant; Headquarters Ross Field,
Arcadia, Cal.

IS THIS A GLIMPSE OF THE EINSTEINS THEORY? THE INFINITELY DIVERSIFIED MOTIONS OF THE HEAVENLY BODIES.

By William H. Knight

The Einstein Theory and the abstruse doctrine of "Relativity," announced as they have been in language somewhat obscure to he lay mind, have proved to be puzzling problems even to many scientific minds. If I have obtained a glimpse of the far-reaching significance of the Einstein propositions, they have to do with the infinitely complex motions of all the heavenly bodies.

We know, for instance, that each one of the innumerable worlds in our Sidereal Universe is not only in rapid motion with respect to all other worlds, but in addition to that each one is probably revolving or rotating round its own axis. Beginning with the earth let us see how this principle works out with respect to all other worlds that exist anywhere in unlimited space.

We are located on the surface of an earth which, in the latitude of Los Angeles, is carrying us forward with a velocity of 700 miles per hour. (In this and other instances I shall, for convenience, use approximately round numbers, in order to avoid loading the text with unnecessarily precise fractional detail.) But we are at the same time flying forward in the vast orbit of the earth as it moves round the sun at the almost inconceivable rate of 18½ miles per second, or 66,600 miles per hour. Now it takes eight minutes for a ray of light to traverse the space of 93,000,000 miles from the sun to the earth.

Suppose then that at this moment a ray of light from the sun should be directed towards the City of Los Angeles, owing to the rotation of the earth, even if it were not moving in its solar orbit, that ray of light would fall many miles west of Los Angeles. But as the earth has moved many miles in its orbit in each second during that eight minutes that suppositious ray will not strike the earth at all, but will dart out into space, crossing the earth's orbit nearly 9,000 miles behind the earth. But if, at the same moment, a ray was directed towards a point in the earth's orbit about 9,000 miles in advance of the earth's position, that ray will be intercepted by the earth and will gladden its inhabitants with its cheerful light and genial warmth, due to that apparently chance impact.

For the same reason, when we look at Jupiter this evening, a planet 400,000,000 miles away, we shall see—not the rays which were directed towards the earth at the moment of observation, but those which, 40 minutes ago, were directed towards a point in our orbit that it has taken our earth 40 minutes to reach. But here comes another complication in the movement of the light

rays of Jupiter. That vast body, like the earth, is whirling on its axis, but much more rapidly, completing the rotation of its huge bulk in ten hours. Thus, rays directed towards the earth, which left its surface 40 minutes ago, have wandered off into far distant space, millions of miles in the rear of the earth's present position in its orbit. But in this case we have not only to take into account the rotation of Jupiter round its axis, but also its motion of 8 miles per second along its orbit round the sun.

Now this complexity of motion is still further enhanced when we take into consideration star motions. Take our own sun, for instance. That mighty orb is transporting its large family of planets, satellites, and comets at the rate of 12 miles per second towards the great sun Vega, shining from the zenith in our summer evening skies, and estimated to be some 30 light years distant—about four times as far away as the bright star Sirius. But our own sun will never reach Vega, for when, in the course of many million years it arrives at the point where Vega now is, that star, which is moving rapidly across our line of sight, will be in a distant part of our sidereal system.

Every star in the universe is in swift motion, either approaching or receding from us, directly or diagonally, or moving across the line of sight in every conceivable direction. But all are moving in vast but inappreciable curves, with radii so large that we cannot distinguish the curves from straight lines. But every star is at such an enormous distance from our solar system that the rays of light coming from each have occupied from four years to 20,000 years in traversing the intervening spaces.

Now each of these stars is probably rotating round its own axis and projecting rays of light from every inch of its spherical surface. Take Polaris for instance—the North Star—a gigantic sun whose dimensions are estimated to be eighty times those of our own sun. While it is whirling on its own axis it is at the same time swiftly circling opposite its big companion round a common center of gravity in a period of four days. Again, these two great suns are moving as a unit in a much larger orbit round a gigantic dark body in a period of about 12 years; and that body is by no means stationary, but moving in as yet an unknown direction through the limitless voids of distant space.

Now if Polaris should this night direct a ray of light towards the earth, both Polaris and the earth being in their present unstable positions in the universe, at the end of 46 years that ray of light would perhaps reach some other world millions of millions of miles distant from our present location. On the other hand, if the North Star 46 years ago, while gyrating on its axis, circling with its companion in its small four day orbit, and also moving with planetary velocity round its masterful dark star, and yet swinging with the wonderful system of which it forms a part far

out into unknown regions of space, if it then sent a chance ray of light out into the infinite abyss of the universe, why, by a miraculous coincidence of chances that identical ray entered the eye of a denizen of the earth, so located on its whirling surface that while the earth was moving with lightning velocity along its orbit round the sun, and was dragged by the sun towards the star Vega, then all the complex, multitudinous, and incalculable conditions involved in the combined motions of both Polaris and the earth would be met. But what a maze of mathematical calculations would be involved in forecasting that result.

When we reflect on the extraordinary motions of Polaris as it pirouettes along its compound curves through space, and at the same time take note of the oscillating and entangling motions of the insignificant body from which we chance to be peering out into the mysterious voids of unlimited space and unending time, we are enthralled with the multitude and bewildering problems involved in an attempt to fix a stable point from which to measure either time or space.

MAGNETISM AND RADIO-ACTIVITY.

William A. Spalding

I hold in my hand an ordinary horse-shoe magnet. It attracts from a short distance—say an eighth of an inch—a small piece of steel or iron which we call its keeper. It also attracts iron filings and various particles subject to its influence, which are termed magnetic substances. It also repels, under varying conditions. The North pole of our magnet repels the north-seeking pole of a compass, and attracts the south-seeking pole. The South pole of the magnet repels the south-seeking pole of the compass, and attracts the north-seeking pole. Hence, we say of magnetism that likes repel and unlikes attract. The same phenomena are found in static electricity, and are easily demonstrable with dynamic electricity as well. This magneto-electric force, called "action at a distance," was the unsolved puzzle of the early philosophers. That inert matter, under certain conditions, could reach out through no other medium apparently than the atmosphere, lay hold of another object and move it, transcended all other human experience. Thales of Miletus, after the manner of ancient Greek philosophy, sought to explain this mystery by attributing to it a greater mystery;—he called it a soul or spirit. It remained for Ampere and Faraday and other patient investigators of the early part of the nineteenth century to demonstrate the character of this force—to show the connection between magnetic and electric actions,—to establish clearly the conditions of its operation and to formulate the laws by which this action is governed. Magnetism was found naturally established in the loadstone—magnetic iron ore—but in manufactured iron or steel it was artificially produced. The modern theory which accounts mechanically for this condition of potentiality, is that it consists of a peculiar molecular arrangement in the magnet itself, whereby the normal electric current which pervades the mass is given a uniform systematic spiral swirl extending from one pole to the other. In other words, the molecules of the magnet are arranged according to their polarity, so that the north pole of each is presented to the south pole of the next in succession, and each line proceeds in a spiral; all of the series composing the mass being arranged in parallel spiral lines. By this arrangement it is believed that the polar activities of all the molecules of the mass are cumulated and given uniform direction, so that the sum of their forces is rendered available. The best demonstration of this theory is that a magnet may be formed by establishing an electric current in just this manner. With a conducting wire wound into a helix, and a current passed through its spiral convolutions from end to end we have what is called a solenoid, which performs all the offices of a magnet. It has its north and south poles, when free to act, adjusts itself

to the cardinal points, attracts and repels;—in fact, does anything that a magnet can do. Thus, in the coil of wire charged with an electric current, we have artificially produced the molecular arrangement which is believed to exist in the magnet, in proof of which we obtain the same results. The one essential difference in conditions is that the solenoid is active only so long as the electric current passes through it; whereas, the magnet, once its molecular status is established say in a piece of steel, remains permanently active until its molecular arrangement is changed, thus so to speak, furnishing its own current. It is this normal electrical flow through a mass of matter to which I desire to give particular attention.

Modern science has been compelled to accept the idea of a universal ether, pervading all space. This ether not only fills the vast reaches between the sun and its system of planets and satellites, but also pervades all concrete matter, furnishing the medium in which the atom and the molecule vibrate as it does that in which worlds rotate and revolve. Not only this, but it pervades all outer space between star systems and constellations and galaxies or "island universes," as they have been called. This universal medium is believed to be perfectly homogeneous, continuous, and infinitely elastic. It is not inert, but in a constant state of agitation, transmitting the vibrations of light and heat, the vibrations of electricity and magnetism, and the stresses and strains of gravitation, whether by vibrations or by some other form of mechanical actions not yet determined. Hence we have the concept of a universal plenum which is the embodiment of energy—a medium through which all natural forces act,—something through which vibrations or other forms of mechanical action are transmitted without loss of power; something capable of transmitting an infinite number of actions in all directions without interference; something that not only applies power to a mass, but which acts with equal facility through the mass upon another object;—something which is a means of actuating the electron, the atom, the molecule, as well as a solar system and a galaxy. Now in this universal, palpitating, quivering, surging plenum we all live and move and have our being. Various phenomena which we obtain through it we have segregated and call by different names: *e. g.,* light, heat, electricity, magnetism, gravitation. Essentially they are all one action, simultaneously propagated, through the same medium, but sheared off into varying effects, which we are able to distinguish one from the other, hence call by different names. Without this energy transmitted through the interstitial ether, matter could not exist, for there would be no renewal of its electric, atomic and molecular activities and no field in which it could vibrate while maintaining the integrity of the mass. Hence we say that energy,—a manifestation of force—is an essential

constituent of matter; and there are some writers who go so far as to claim that matter is nothing but force in various forms of manifestation. We know that, within certain critical limits, there is a constant ebb and flow of such energy, for matter is continually changing temperature and molecular adjustment; continually expanding and contracting as it absorbs or parts with a portion of its heat supply. There are causes which communicate to the electron, the atom and the molecule an excess of energy, causing higher rates of vibration, extending their orbits,—expanding the mass. The process of equilibration comes in to dissipate the surplus energy in radiation and convection—to equalize temperatures all along the line,—and the mass contracts. Heat is a mode of motion, and the variable quantities of this form of energy absorbed by the mass must be taken up in the motions of its constituent elements. This augmentation or dissipation of contained energy pressed beyond either critical limit, up or down, results in a radical modification of the molecular bond, and matter changes form; as water to ice at one extreme, and to steam at the other. Hence we know that the energy contained in matter and constituting one of its essential elements, if not the whole thing, is a variable quantity, subject to dissipation, renewal, augmentation; and on the amount of energy embodied depends the form that matter assumes.

Now, returning to the magnet with which we began our discussion, we find additional light thrown upon the subject. The play of energy through this object with its peculiar molecular adjustment has been systematized, cumulated, directed, focused, and becomes the force which we call magnetism. Investigation discloses that there are little thread-like, curved, invisible lines of force reaching out from the poles of the magnet, and joining them together like the glow of an arc-light. It is these lines of force which take hold of the keeper and bring it into contact with the poles of the magnet, where it is firmly held. If we wish the magnet to draw a diagram of these lines of force, we have only to sprinkle some iron filings upon a piece of paper and hold it over the two poles. The filings will be quickly arranged along such curved lines, and they will all be placed longitudinally, according to polarity. A further examination would show that each particle in line presents its own north pole to the south pole of the succeeding particle, thus exemplifying the arrangement which we have hypothecated for the magnet itself. Now we have this mysterious force, this "action at a distance," diagramed by itself. We can see how, if not why, it is capable of reaching out with its invisible fingers, and performing a physical action. Ampere demonstrated that this magnetic force varies directly with the power of the magnet and inversely with the square of the distance, in close correspondence with the law of gravitation. That is why our magnet was

capable of drawing its keeper from only a short distance—about an eighth of an inch—whereas, when the keeper was in actual contact with its two poles, it required a pull of a pound or more to wrench it away. The force is at its maximum when the objects are in actual contact, and diminishes by squares as they are separated, so that the power to move a small object, weighing not more than a pennyweight is lost at a little distance. But this power which the magnet exercises, within its peculiar limits, seems to be permanent. We might experiment with it all day, alternately picking up the keeper and wrenching it away, and at the end find that the magnet had lost no appreciable part of its power. We might continue the experiment for a week or a month, and still not find sufficient loss of power to account for the amount of work performed. If we belonged to that class of scientists who delight in building up mysteries, we might institute a series of experiments where the exact amount of work performed should be carefully calculated and reduced to foot-pounds, or horse-power, and we might fill columns in the newspapers and pages in the magazines proclaiming the wonders of a force subject to constant expenditure in work, yet not dissipated. As a matter of long experience, we know that the power of a magnet does slowly leak away, not as a direct equivalent of work performed, but as the molecules of the mass gradually lose their alignment. If weakened or exhausted, its power may be fully restored by the same process which originally magnetized it. The fallacy of building up a mystery about it would lie in assuming that the power was inherent in the magnet itself,—*i. e.*, presupposing a definite amount of energy embodied in this bit of metal, and then showing that it had performed many times that equivalent in work. We have seen that the peculiar spiral arrangement in the molecules of the magnet, made of it an attractive conduit for drawing in the unicentrating and applying forces everywhere extant in the universal plenum, of which there is an exhaustible supply. As its energies were put forth they were continually renewed through the interstitial ether, and its power was lessened only as its capacity for furnishing a channel for this flow of force was impaired;—in other words, as its molecules became disarranged. As long as its capacity remained, it could draw upon the universal forces of nature. There was no chance for it to run out of energy, *per se*.

Now that I trust I have made this point clear, I am emboldened to take up the subject of radium and radio-activity. And I cannot avoid the belief that the proponents of the theory of radium have adopted the plan of mystification suggested as possible for magnetism. They have assumed that the power of radium is inherent in the mass itself. They tell us that this metal is capable of giving up its constituent particles, electrons,

for two thousand years, in an almost inconceivable activity, with a diminution in mass of only one-half; in another two thousand years one-half of the remainder, and so on. Now this is pure theory, of course, based upon most intricate calculations of molecular, atomic and radiographic data. But a false assumption at the start vitiates all calculations. Nobody has experimented with radium for two thousand years. Nobody has actually demonstrated what they put forth as facts.

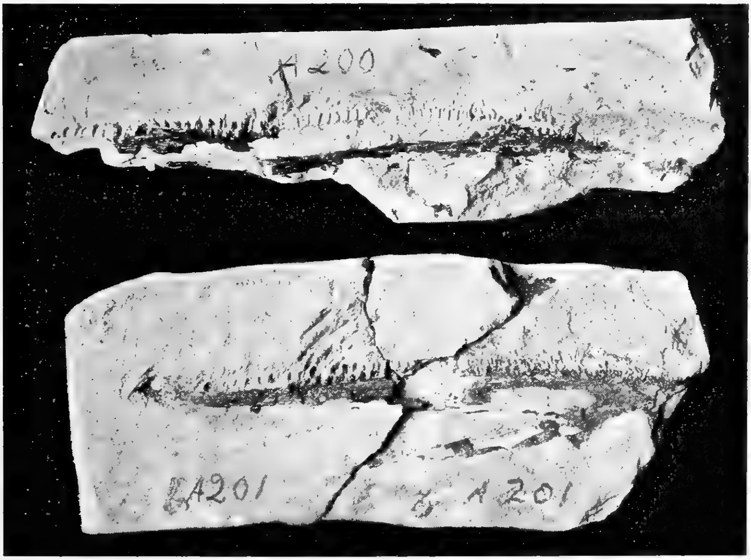
For a long period the most advanced scientists in the world held to the corpuscular theory of light. Sir Isaac Newton was an illustrious advocate of it, and nobody dared stand against his authority, his masterly demonstrations and arguments. Nevertheless the corpuscular theory is now discredited and the undulatory theory has come into general acceptance. Why should the proponents of radium go back to the dogma of emanations—the corpuscular theory—for an explanation of the phenomena of radio-activity? Would it not be far more reasonable,—even if less astonishing—to assume that there is an arrangement of the ultimate particles of radium which facilitates the flow of natural forces embodied in the universal ether, similar to that outlined for magnetism? Nobody would hold that magnetic action is identical with radio-activity; but there is a disseverable bond between magnetism and electricity; there is a bond between electricity and radio-activity; may it not be a fact that radium is a sort of second cousin to the magnet after all? There is a slight magnetic effect in radium; it influences the south pole of the compass. At any rate, the idea of an inexhaustible supply of energy in nature flowing through the peculiar channels supplied by radium would account much more satisfactorily for the potentiality and long endurance of the new metal than a theory of emanations that does not waste or dissipate the mass, or at least disintegrates it so slowly as to be unbelievable?

FAMILY MURÆNIDÆ

J. Z. Gilbert

Deprandus Lestes. (Jordan & Gilbert, new genus and species. With Plate.

The type of this muray (201A) from El Modena, diatomaceous shale, was sent to me by Dr. Gilbert, a lower-jaw, 3½ inches long. It is slender, straight, curved upwards toward the tip, and shows a single row of strong, conical sharp teeth, somewhat thickened at base, rather close-set, the interval being a little more than half the length of a tooth. The teeth on the middle of the jaw are a little larger than the others, those in the posterior third of the length are more slender, close-set and apparently in a band, rather than a single row, all the teeth directed more or less backward. There is no trace of lancet-like teeth or of canines. Tip of the lower jaw apparently turned upwards. On



the fossil are traces of the teeth of the other or right side of the jaw, indicating that the mouth was narrow as well as long.

Another half of a lower jaw (200A) also from El Modena, retained by Dr. Gilbert, is slightly larger, but shows no difference.

The type specimen was obtained from the fossil collection of Mr. E. E. Hadley.

Another lower jaw from a much larger fish (No. 571) sent to me from Alhambra, Los Angeles County, by Mr. E. E. Had-

ley. This is in all, about six inches in length. It apparently belonged to a very large moray with long and slender jaws. The posterior part of the jaw has been broken, the teeth obliterated, but on the anterior part is a row of stout, conical, sharp-pointed teeth, all turned forwards, the length of each nearly double the interspace which separates it from the next. These teeth are all of about equal length, none of them enlarged or lancet-shaped. In the space of two inches there are about forty teeth. The bones of the jaw are rather strongly striate.

These jaws belong apparently to the same species, which seems to have been a large muraenoid eel or moray, allied to the cosmopolitan living genus *Gymnothorax* (*Lycodontis*) one species of which, *Gymnothorax mordax* still abounds on the coast of southern California.

The new genus, *Deprandus*, may be distinguished from *Gymnothorax* by the very long jaws and the peculiar dentition. As to its nasal barbels and the insertion of the dorsal fin nothing is known.

I have also another lower jaw of an eel, from Alhambra, about two inches long with a single row of sharp close-set teeth, those behind a little shorter, some toward the front somewhat longer, the teeth all sharp and turned forward. This may represent a different species.

ON THE DISTRIBUTION OF CERTAIN TREES IN CALIFORNIA.

S. B. Parish

Holacantha Emoryi Gray. The first collection of this species in California was made by Dr. J. G. Cooper in 1861, and his reported station was "Providence Mountains," a desert range in the southeastern corner of the Mojave Desert, a region where a number of Arizona plants extend over to this side of the boundary. Its flora is still imperfectly known, but the very few botanists who have visited it in recent years have not found Holacantha there. Indeed it remained unrediscovered in the state until January, 1915, when specimens were received by Dr. Jepson from Mr. R. H. Greer, who had collected them at the Lava Beds, northeast of Daggett. In 1919 Miss R. S. Ferris reported in this Bulletin (18:13) finding it near Ludlow, and in a recent number (19:15. 1920) Mr. G. D. Thompson states that prospectors had given him specimens from two stations near Goffs; one twenty-five miles north and the other twenty miles to the south, in a wash on the road to Ward's Station. In May of the present year Dr. P. A. Munz and Mr. I. M. Johnston found it growing in abundance along a wash about four miles east of Lavic, extending, at least, from the highway to the railroad; the matted shrubs not exceeding four feet in height. All these stations are in a limited area of the Mojave Desert; some of them are probably identical, and it is not impossible that Dr. Cooper may have collected his specimens within it, where it appears not infrequent, so that it is remarkable that it remained so long unrediscovered.

In 1914 Dr. Jepson received from Mr. James Rennie specimens of Holacantha from a place known as the Hay-fields, in the Colorado Desert, and in May of the present year Mr. E. E. Schellenger brought me specimens from the same place, which is about twenty-five miles east of Mecca, on the road to Blythe. The road divides here into several branches, and only one of them passes through the group, which consists of numerous tree-like shrubs, the largest about eight feet high. This is the western limit of the species, and is seventy-five miles from the Mojave stations, and separated from them by a desert range.

Celtis Douglasii Planch. A few specimens in some of the larger herbaria were the only evidence of the presence of this species in California, and the foundation on which it was reported, under a different name, in Sargent's Sylva (7:72), and in subsequent publications, from "the western rim of the Colorado Desert." They were collected in 1885, by Mr. Daniel Cleveland, the first, and long the only, botanist residing in southern California. The station given on the label is "Laguna," the name of a mountain in the southeastern part of San Diego county,

forming a part of the western rim of the desert. In the spring of 1919 I was requested by Dr. Sargent to definitely locate Mr. Cleveland's station, and to ascertain the extent of the distribution of the species in that region. Through directions kindly given me by Mr. Cleveland I was able to find the very tree from which his specimens were gathered, which is a well-known object to the cattle-raisers whose herds range over this region. They are confident, from their familiarity with the district, that it is the only "Hackberry" growing on this side of the Mexican boundary, although some of them had seen similar shrubs growing at some distance on the Lower California side.

In 1885 a road led from Campo to the summit of Laguna mountain, but at present it is passably only to Thing's Valley, fifteen miles northeast. This is a small meadow in the rugged mountains, densely covered with a mixed chaparral, which physically characterize the whole region. Here, on the open zone which separates the chaparral and the meadow, grows a close clump of a dozen stems, appearing as if coming from a single root, their interlocked branches uniting in a top fifteen feet high, and spreading from twenty-five to thirty feet wide. Mr. Cleveland noted the height as twelve feet, and as both measurements are estimated there would seem to have been little, if any, incrase in thirty-four years.

There are two other known stations for this tree in California, each attested by specimens in the herbarium of the State University. One of these is Hackberry Canyon, a tributary of Caliente Creek, Kern County, where, in 1910, Mrs. K. Brandegee found a group of small trees, the largest nearly three feet in circumference. The tree is also said to grow on Caliente Creek itself. The other station is Independence, Inyo County, altitude 4000 feet, where Dr. H. M. Hall found specimens, the largest fifteen feet high, growing among Artemesias in a depression in the southwestern edge of the town.

CUPRESSUS MACROCARPA, Hartw., and its allies. There is in California a group of Cypresses distinguished by the low, upwardly-impressed umbo of the cones, and consisting of three closely-related species, of discontinuous and very limited distribution. The best known of them, *C. macrocarpa,* "is the most restricted in its distribution of any Californian tree, and of any coniferous species in the world." (Jepson, Sylva 155.) In fact there are but two native groves, both confined to the immediate seashore of the Monterey peninsula. The first is about two miles long, and although containing thousands of trees does not extend more than sixty rods back of the edge of the sea cliff; the other, much smaller, crowns the rocky headland of Point Lobos, near Carmel. This confined natural habitat is in marked contrast to the adaptability shown by the species in cultivation in many parts

of California, as well as in South America, Europe and Australia. In New Zealand it is successfully used in the reclamation of dunes.

C. GOVENIANA GORD, likewise a maritime species, is a shrub found in disconnected groups from Monterey to Fort Bragg. C. SARGENTII Jepson has a wider and more inland distribution, from southern Mendocino County to Tecate mountain on the boundary between San Diego County and Lower California, but it occurs only in groups of limited extent in a few isolated localities.

There have also been found fossil remains of a cypress such as these in Pleistocene deposits in two localities where none now grow; some cones at San Francisco, and a trunk in the Brea deposits near Los Angeles. Considering the present distribution of these cypresses, and their slight specific differentiation, it is not unreasonable to trace their genetic affinities to a Pleistocene forest, which may have stretched far along the coast, of which the present representatives are but the scanty relics.

BRICKELLIA MICROPHYLLA (Nutt.) Gray.

GEORGE L. MOXLEY.

On Sept. 15, 1920, Mr. Frank W. Peirson collected a plant on Lytle Creek* that seemed to us to belong here. To make sure of the determination I sent a specimen to Dr. B. L. Robinson, of Gray Herbarium, who confirmed our judgment. In his reply, Dr. Robinson says: "It was with some hesitation that I could bring myself to believe when working upon the genus *Brickellia* that specimens from Cedros Island were the same as those of *B. microphylla* from central California and northward. The discovery of an intermediate station in the San Bernardino Mountains is an important step in bridging this long gap in the previously known geographic distribution of the species." Mr. I. M. Johnston also reports it (Plant World 22:119. 1919.) from both the San Antonio and North Fork Lytle Creek Canyons.

*Lytle Creek, San Bernardino Mts., California, alt. 1800 m., Sept. 15, 1920, Frank W. Peirson, no. *2279*.

NEW SELAGINELLAS.

In a recent number of the Smithsonian Miscellaneous Collections Mr. William R. Maxon describes six new species of *Selaginella*, three of which are from material collected in our region. *S. eremophylla*, type from Palm Canyon; *S. asprella*, type from Ontario Peak, San Antonio Mts.; and *S. leucobryoides*, type from Surprise Canyon, Panamint Mts., Inyo County. All these, as well as the three species heretofore credited to Southern California, *S. bryoides* (Nutt.) Underw., *S. Watsoni* Underw., and *S. Bigelovii* Underw., belongs to the *rupestris* group. Other interesting forms may be looked for.

NOTAE PLANTARUM AUSTRO-OCCIDENTALIS. I.

Since the publication of my note concerning the proper name for our Californian species of Thelypteris (Bull. So. Calif. Acad. XIX:57. 1920.) my attention has been called to the fact that T. normalis (*Dryopteris normalis* C. Chr.), to which I referred our plant, is a species of the West Indies and the Gulf coast of the United States and does not likely reach our borders. Our fern is more properly referred to *T. Feei,* which is a Mexican species and, consequently, more likely to show up in Southern California. It is, however, the fern which in many instances, as previously pointed out, has been called *Dryopteris patens* (Swz.) Ktze., which species, in its typical form and several varieties, is distributed throughout the whole of tropical America. This determination is manifestly incorrect, and the proper name for our plant, together with its synonymy, is given herewith.

THELYPTERIS FEEI (C. Chr.) new comb.

Aspidium puberulum Fee Mem. Foug. 10, 40. 1865. not Desv. 1827.

Nephrodium puberulum Baker Syn. Fil., ed. 2, 495. 1874. *Dryopteris puberula* Ktze. Rev. Gen. Pl. 2:813. 1891. *Dryopteris Feei* C. Chr. Ind. Fil. 264. 1905. *D. augescens* var. *puberula* C. Chr. Monog. Dryopt. pt. 1, 184. 1913.

PLANTAGO ARISTATA Michx.

A single plant of this species was collected in the parkway at the corner of 30th and Cimarron Sts., Los Angeles, Aug. 20, 1920. It is undoubtedly a waif but, like many another, may reappear in increasing numbers.

GEORGE H. BEEMAN

By William A. Spalding

This Academy of Sciences lost a Director and a staunch supporter in the death of George H. Beeman, which occurred January 12th, 1921. He was a young man, only 37 years of age and, with his mental capacity and fine moral balance, gave promise

GEORGE H. BEEMAN

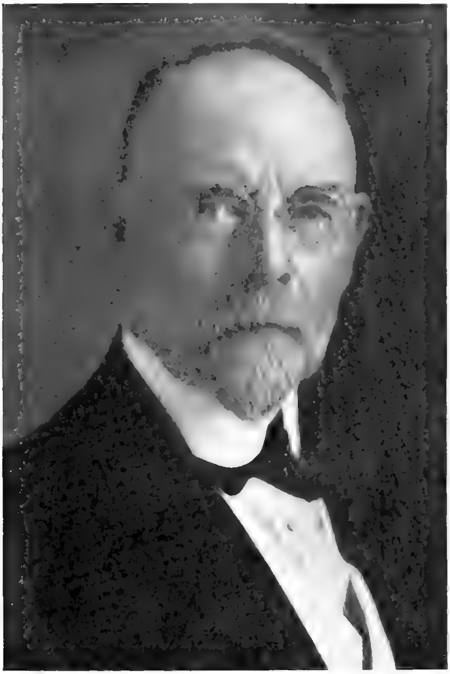
of a long life of usefulness. But he was stricken with a painful malady, ulceration of the stomach, and after fighting a brave but painful and hopeless conflict for several months, was thus early called from his field of usefulness.

PROFESSOR WILLIAM LORD WATTS

By Geo. W. Parsons

With the advent of the new year, the scientific world lost one of its noted Mining Engineers and Geologists, Professor William Lord Watts.

Born in Edmonton, England, September 24th, 1850, of William Lord and Eleanor Watts, he started his brilliant career as a St. Paul's Boy. Later, he studied minerology under Professor Tennant and geology under Professor Wilshire at King's College, London, England, and was a private student of the British Museum. Under Professor Patrick of the University of Kansas, he received his knowledge of chemistry and metallurgy. While a member of the Alpine Club of London in 1875, he lead an exploring expedition to Iceland and was the first man to cross



PROFESSOR WM. LORD WATTS

Vatna-Jokull, the largest icefield in Iceland. From 1881-83 he was assistant to Professor Patrick and the next year was chemist and assayer to the Oregon Mountain Mining and Smelting Company. In 1880 he married Mary Riordan and fifteen years after her death, married Euphemia F. Sterling.

In the Winter of 1901-1902 Professor Watts accompanied the writer on his Desert Sign Post Expedition into the deserts of California and Nevada, which resulted in State and United States Government support, and a saving of life and much torture from thirst.

In 1894, the Los Angeles Chamber of Commerce petitioned the State Mining Bureau to send an expert here to study the oil and gas bearing formations. Professor Watts was chosen, and his report stimulated later activity, and was really the beginning of the immense development which quickly followed.

He was a member of the American Institute of Mining Engineers, Director and Fellow of our Southern California Academy of Sciences, and prominent in the Masonic Fraternity, Los Angeles Chamber of Mines and Mining and of the Academy of Sciences San Francisco. He wrote numerous reports on oil conditions and was the author of "Snioland or Iceland, 'It's Jokuls and Fjalls"—1875; "Bulletin No. 3 California State Mining Bureau"; "Gas and Petroleum Yielding Formätions of the Central Valley of California and contributed largely to California State Mining Reports 8, 10, 11, 12 and 13. In 1876 he wrote another book on his Icelandic adventures "Across the Vatna Jokul."

At the time of his death, which occurred on board the S. S. Navarre at Sea, January 2nd, 1921, Professor Watts was returning from London to Trinidad, British West Indies where he was associated as geological expert for the Kern River Oil Fields Company of California, Limited.

Under Louis 14th, members of the Academy of Paris were granted pensions for life. Other cities in France emulated Paris and academies were established in Montpelier, Toulouse, Nunes, Arles, Lyons, Dijon, and Bordeaux.

The Royal Academy of Sciences was established at Berlin in 1714. Alexander Von Humboldt was one of its members. Catherine of Russia established an Academy of Sciences in 1728 and endowed it with a sum equivalent to $24,000. Sweden, Denmark and the Netherlands had their academies. The Royal Society of London, the most distinguished scientific body in the world, grew out of what was first called an Academy of Sciences.

GEORGE MAJOR TABER

By S. J. Keese

It is with sadness that we add Mr. Taber's name to the list of Members and Directors of the Academy who have passed from among us since the last issue of the Bulletin. Mr. Taber was for many years, our Treasurer, and his writings on scientific and other interesting subjects, are to be found in many of the Bulletins.

He was born in Starksboro, Vermont, November 17th, 1832, and died at the home of his daughter, Mrs. May Allured, on West

GEORGE MAJOR TABOR
Daguerrotype taken by himself in 1852

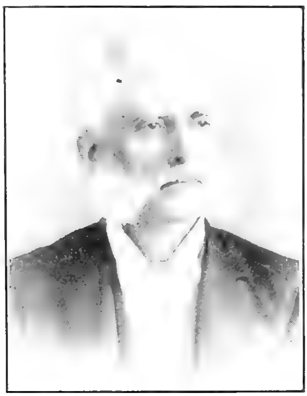
6th Street, Los Angeles, November 14th, 1920, the funeral being held on the anniversary of his eighty-eight birthday.

After finishing his education at Middlebury, Vermont, he taught school in both Upper and Lower Canada; later he became expert in the new system of Daguerreotype photography, which he followed for a number of years. A reproduction of a photograph which he took of himself by this process in February 1852 is shown herewith; also a half-tone taken in his later years.

In 1856 he was appointed to the Chief Clerkship of General Fletcher, who was Agent to the Winnebago Indians in Northern

Minnesota, and had charge of issuing supplies to that tribe. In 1859 while residing in Iowa, he became acquainted with John Brown, and Mr. Taber dined with him the day Brown left for his raid at Harper's Ferry, and to whom Brown outlined his plans for liberating the slaves. During the Civil War, Mr. Taber had charge of the Quartermaster's Department at Nashville, Tennessee, where all of the stores for the Army of the Cumberland passed through his hands. He was present at the battle between Generals Hood and Thomas at that time. In a letter he wrote regarding this he said, "After witnessing 80,000 American citizens trying to kill each other, I am convinced that none but barbarians would be guilty of such wholesale murder."

During the War, he was called to Decatur, Alabama, on military duties, where he remained until the close of the War He was then detailed to go to a mountain camp of the Confederates to advise them of Lee's surrender; using his words, he says, "When I arrived at the camp, a Lieutenant grabbed my horse and



GEORGE MAJOR TABER
1916

said 'Yank, what are you going to do with us?' I responded, 'You have been bad boys, but if you will go home and be good citizens, no one will disturb you'." Later, while a delegate to the Chicago Convention, which nominated Grant and Colfax in 1868, he met this same Confederate Lieutenant.

In later years, he was Chief Clerk of the Internal Revenue Office at Lansing, Michigan, and also Chief Clerk to the Secretary of State. In 1893 he removed to California, where he made his home, and where he had been a faithful Member and Officer of the Academy of Sciences.

Some years ago Mr. Taber published an interesting history of the name "Academy of Sciences" and its adoption by distinguished

scientific bodies in Europe and America. We give herewith a brief summary of the article which involved considerable historic research.

According to Greek tradition Academus had a beautiful grove in a suburb of Athens which he devoted to the use of scholars, literature and science, and here Socrates, Plato and Xenophon met and taught the youths of Athens ethical and scientific truths nearly 400 B. C. and the grove became known as "The Academy."

Coming down to the Augustan age of Rome, Cicero named his garden the Academy and there illustrious people from all parts of the Empire met from time to time. When the Alexandrian Library was founded near the mouth of the Nile, it became the chief scientific center of the early Christian era.

Alfred the Great established an Academy at Oxford in the 8th century and it became the great University of Oxford. The Saracens founded academies of learning in Northern Africa and Spain. Charlemagne established academies in the Franco-German dominions where he ruled. In the renaissance of Italy several academies were organized, of which the principal one was the Platonic Academy at Florence.

DEATH OF MRS. MARY E. HART

The Academy of Sciences was first organized under the name of the Southern California Science Association in October, 1891, and Mrs. Mary E. Hart was its first Secretary. She took an active interest in promoting its welfare, and continued to serve in that capacity till she was succeeded in 1893 by Mr. B. R. Baumgardt.

MRS. MARY E. HART and Alaskaa Dog Team

In 1900 she went to Alaska to join her husband, Judge Frank B. Hart, who was engaged in mining in that territory. There she entered uopn a literary career, writing for the local and California press. She usually spent her winters in Los Angeles where she gave lectures on Alaskan scenery and mining life. In January, 1910, she represented her Territory in the Alaska-Yukon-Pacific Exposition, held at Seattle, and received a gold medal for her services. Her death occurred in this city in March, 1921, at the age of 68 years.

W. H. K.

BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

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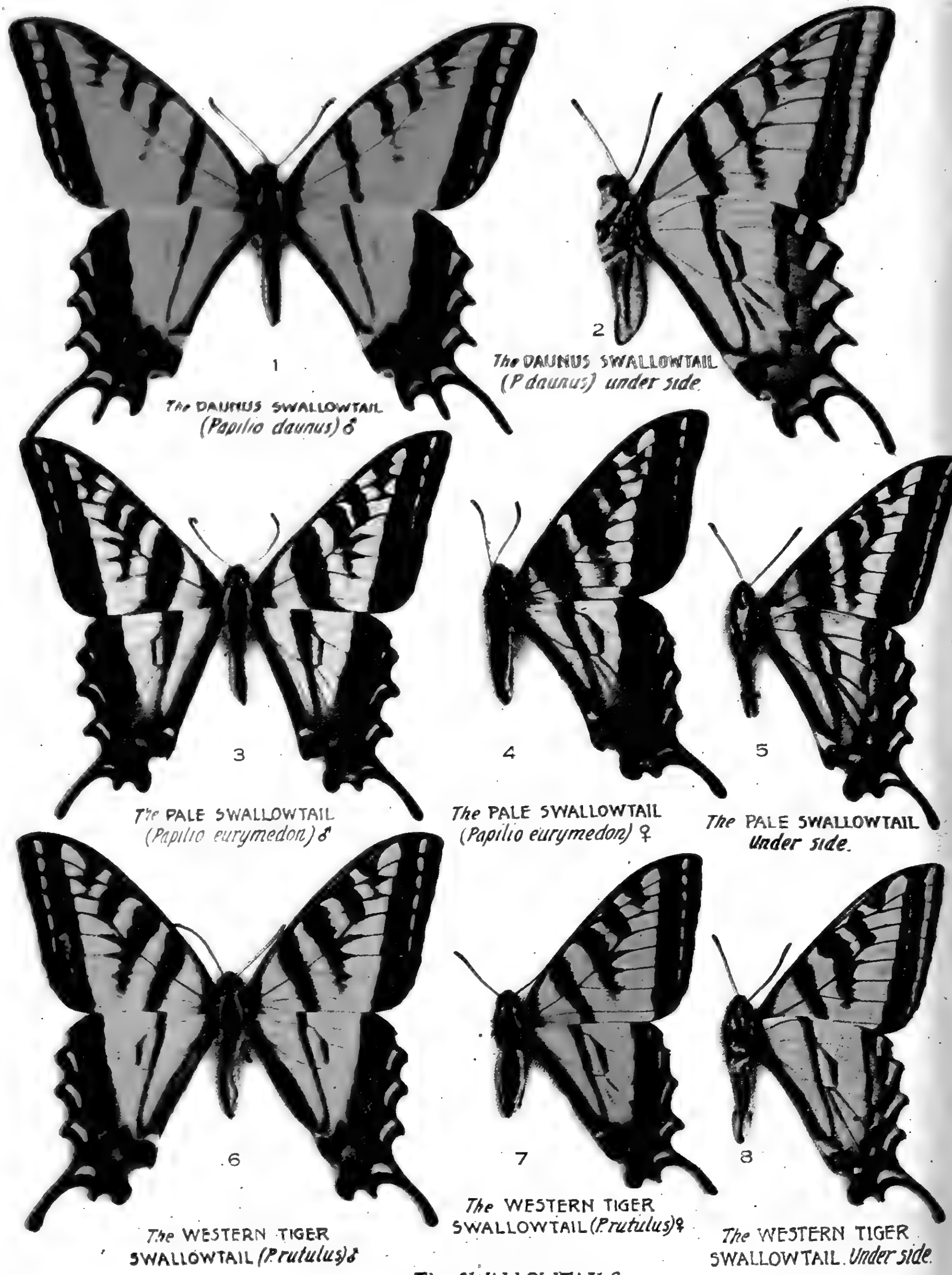


The SWALLOWTAILS

BUTTERFLIES OF CALIFORNIA

DR. JOHN A. COMSTOCK

(*Continued from Vol. XX., Part I. Page 6*)

THE DAUNUS SWALLOWTAIL (*Papilio daunus, Bdv.*)

Plate IV., Fig. 1, male, upper side. Fig. 2, male, under side.

THE DAUNUS SWALLOWTAIL occurs sparingly from northern California to the Sierra Madre Mountains, its range being largely confined to the eastern slopes of the Sierras. It may be met with from early spring to August, sailing majestically over the water courses of mountain canyons,—and can be distinguished at once from its near relatives by the presence of an extra pair of tails and the curved prolongation of the anal angle. Its long season suggests that it is double brooded.

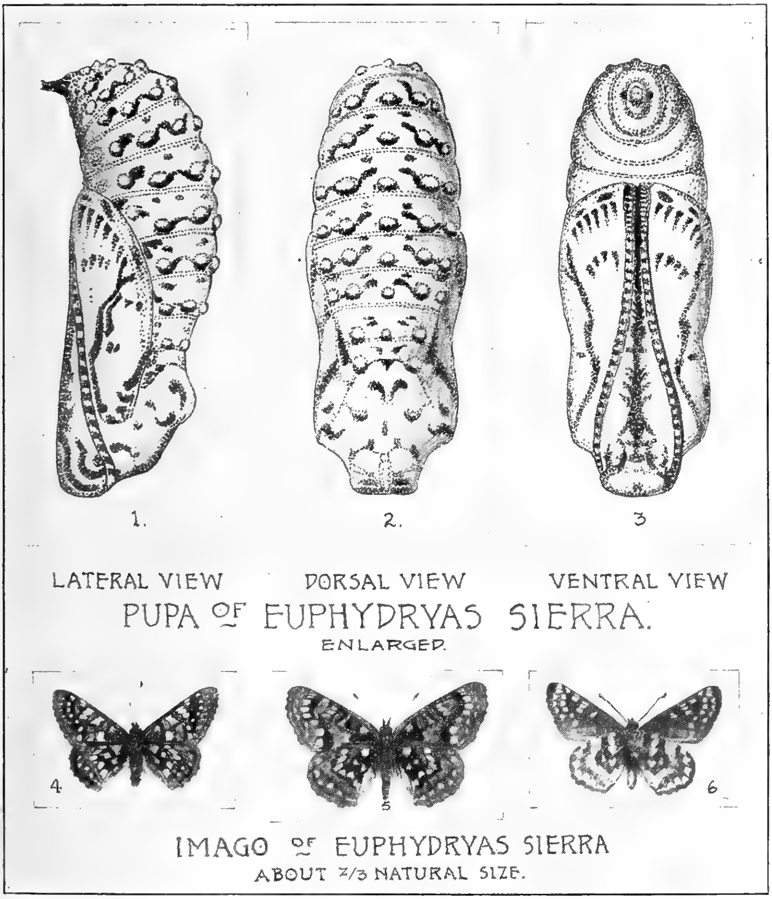


Plate A

The larvæ feed on a wide variety of plants, including a number of rosaceous species such as Prunus demissa (wild cherry), etc. It has also been recorded on Salix (willow).

THE PALE SWALLOWTAIL (*Papilio eurymedon, Luc.*)

Plate IV., Fig. 3, male. Fig. 4, female. Fig. 5, male, under side.

THE PALE SWALLOWTAIL is abundant throughout the state from early spring to mid summer. It is an occasional capture in the lowlands, but is more at home in the canyons and upland meadows of our mountain ranges, where one may often capture it in great numbers as it sips the nectar of thistles, or drinks from the moist sands at the side of mountain streams. Felder has distinguished a form which he has called *albanus,* "of smaller size and clearer white ground color; tails long and narrower; marginal spots nearer the margin." The name seems hardly worthy of retention.

The larval food plants include *Rhamnus california* (California wild coffee).

(*To be continued*)

Note: Plate III of this series has been temporarily held up in the printing, but will be included in a subsequent issue of the "Bulletin."

STUDIES IN PACIFIC COAST LEPIDOPTERA

Dr. John A. Comstock

EARLY STAGES OF EUPHYDRYAS SIERRA, WRIGHT

(*Illustrated by the Author.*)

During a recent expedition into the Yosemite region I was fortunate enough to secure two specimens of the larva of *Euphydryas sierra,* which were carried through the pupal stage, and one of which emerged.

The larvæ were observed by Dr. Carolyn Comstock on what we believe was a species of *Montia.* They pupated without further feeding, on July 2nd, and one emerged on July 13th. The following notes were made of the larvæ and pupæ.

LARVA, LAST INSTAR. Closely resembles the larva of *E. chalcedon.*

Head: black, covered with numerous stubby black hairs.

Body: longitudinally striated alternate black and creamy-white,—the whitish striations being interrupted with blotches of yellow at the base of spines. These lighter colored bands are five in number,—one placed dorsally, two laterally, and two latero-inferiorly. The body is covered with many branching spines. Those which arise from the area of the dorsal cream-colored stripe are yellow, with the exception of a single caudally placed one, which is black. A short latero-inferior series of spines on each side are also yellow. All the remaining spines are black.

First Segment: contains a number of stubby hairs and two short laterally placed spines.

Second and Third Segments: eight spines, the two most laterally placed yellow,—the remainder black. There is no mid-dorsal spine.

Fourth to Eleventh Segments: nine spines, the mid-dorsal series and the latero-inferior series yellow,—the remainder black.

Caudal Segments: spines are reduced in number and size. All are black.

Legs: black. *Abdomen*: greyish white, with an indistinct dark median line.

PUPA. Length 18 mm. Greatest width through 5th abdominal segment on a lateral axis, 6 mm. Through 5th segment on a dorso-ventral axis, 7 mm. Very similar in general appearance to our common *E. chalcedon.*

Ground Color: silvery white, changing to a grey-green. Over this are scatterer numerous brownish-black blotches, and striations. A number of papillæ occur at points corresponding to the larval spines. These are tipped with yellow.

Antennal Sheaths: checkered alternate black and grey-green.

Head Region: heavily blotched with brownish-black.

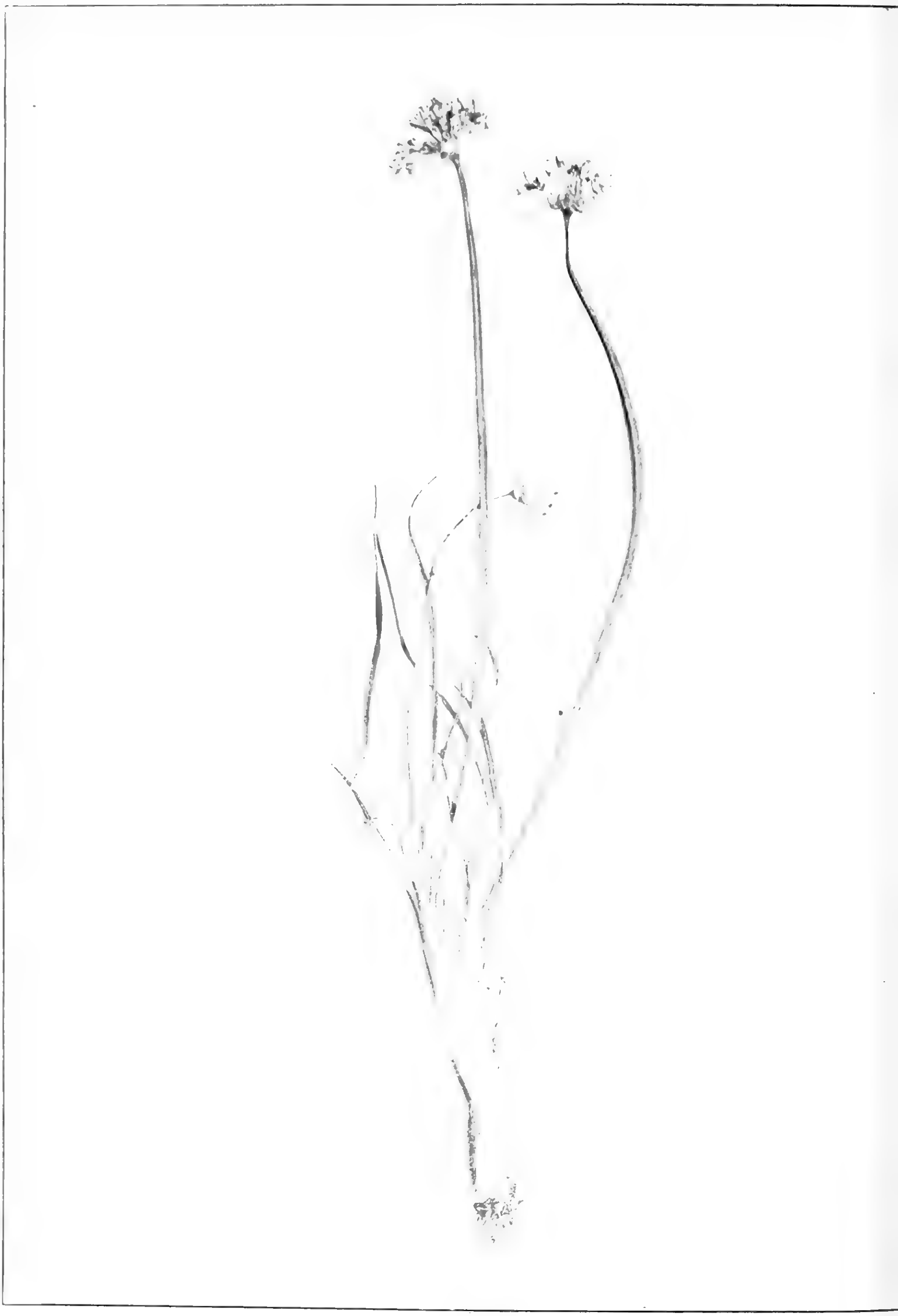
Wing Cases: an irregular brownish-black line crosses tangentially, which bears a fanciful resemblance to the letter Y with an elongate tail. Two rows of dark spots occur near the outer margins, the row most laterally placed having six, the other four spots.

Abdominal Segments: grey-green or silvery white, with numerous minute papillæ, tipped with yellow and shaded anteriorly with blackish-brown crescentic spots.

EXPLANATION OF FIGURES.

Plate A. Fig. 1. Lateral view of Pupa of Euphydnyas Sierra, Wright. Fig. 2. Dorsal view of same. Fig. 3. Ventral view of same,—all greatly enlarged.

Fig. 4. Upper side of male Euphydryas sierra. Fig 5. Upper side of female of same species. Fig. 6. Lower side of male, same species,—all reduced to about 2/3 natural size.



ALLIUM MARVINII (Davidson)

NEW SPECIES FROM SOUTHERN CALIFORNIA

A. Davidson, M.D.

ALLIUM PSUEDOBULBIFERUM n. sp.

Bulb 12 mm. in diameter, acutely ovate, smooth; the vertical underground stem carrying the scaly remnants of 2 or 3 old bulbs 2 cm. apart; the active bulb terminal; stem 2 dm. high, terete; leaves 2, linear above, 3 mm. wide at base; pedicels about 18 mm. long; perianth white, the segments 6 mm. long, ovate, acute with a green midrib, inner segments slightly smaller; stamens slightly exserted; stigma 4 mm. long, undivided; ovary smooth, 3 lobed with a slight grooved depression on each lobe.

No. 3410, type specimen, from elevated ground east of the river at Victorville. Collected by *Robert Kessler,* May 1, 1921.

This has probably passed as *A. serratum* but is differs from species in having the stamens exserted and it differs moreover from all the other Alliums in this section in possessing a Calochortus like bulb which is periodically renewed by the deeper extension of the stem exactly as seen in *Calochortus Plummerae.*

ALLIUM KESSLERI n. sp.

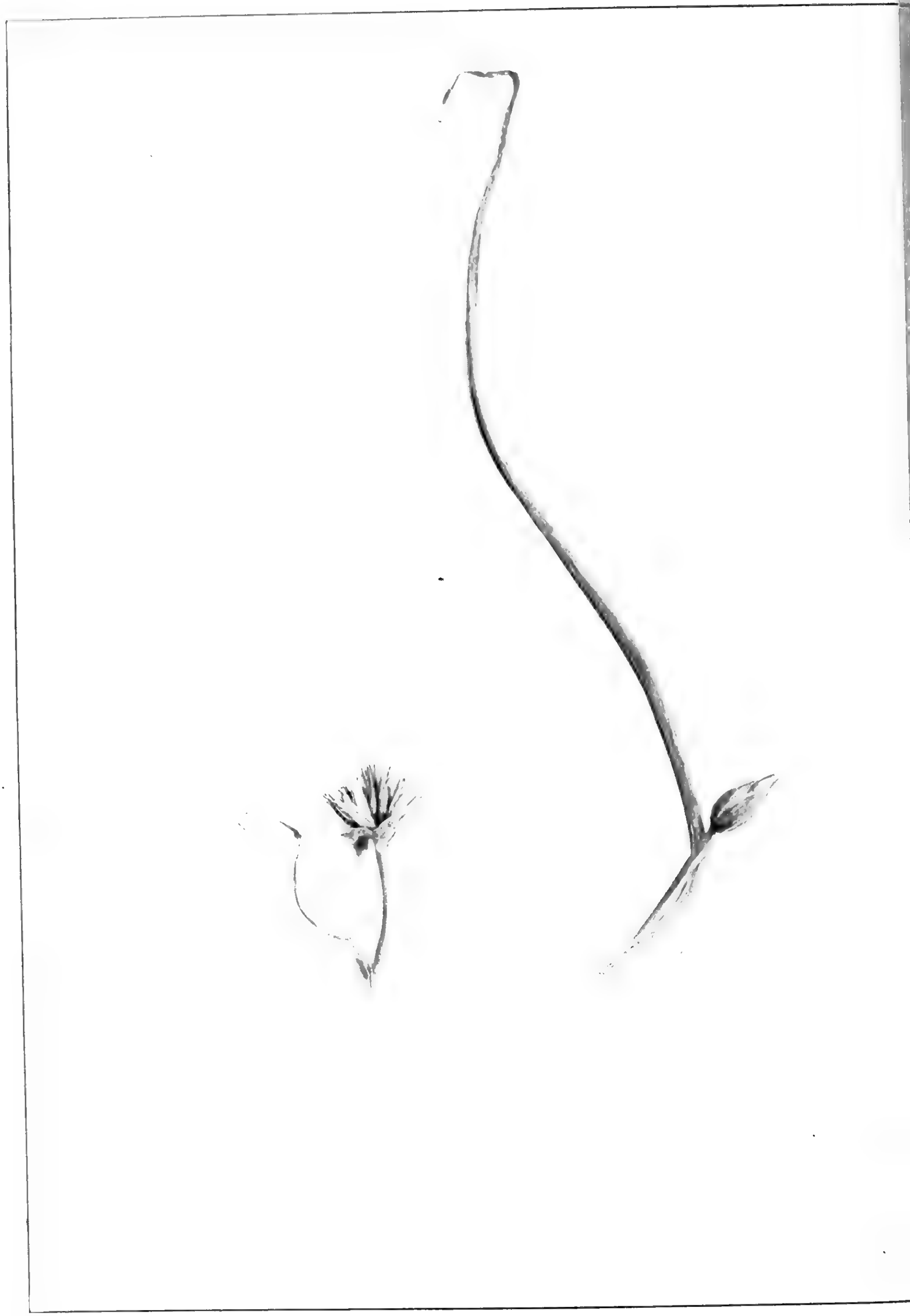
Bulb globular, 8 mm. in diameter the brown coating without definite reticulation; stem solitary 10 cm. long, terete; leaf single, linear, longer (sometimes twice the length of the stem) and sheathing the base of the stem for one-fifth of its length; perianth whitish fading to light lavender; pedicels about 10, 2 cm. long; perianth segments lanceolate, 6 mm. long, the outer slightly larger, whitish with light green midvein on the outer 3, this vein indistinct or obsolete on the inner segments; stamens widening slightly to the base two-thirds the length of the perianth; style 4 mm. long with 3 linear stigmas; capsule with 6 small, rounded crests topped with the remains of the cellular structures so conspicuous in anthesis.

No. 3409, type specimen. Common on gravelly slopes on Little Bear Creek, San Bernardino Mts., *R. Kessler,* June, 1920.

In general appearance and habit this plant looks like a light colored specimen of *A. Parryi,* but it is of a taller more erect habit, the flowers are not so deeply colored, their segments are shorter and are not retrocurved at the tip as are those of *A. Parryi.* The stamens in *A. Parryi* are linear, and the capsules are erose on their summits.

ALLIUM MARVINII n. sp.

Plant 2-3 dm. high; bulb oblong, tunicate, the outer coat brown, rough, the inner white, smooth and glistening; leaves 5-6 all basal, one-half the length of the stem, somewhat fleshy, concavo-convex and 5-8 mm. wide at base, semiterete at apex; stems 2 or more, slightly angular below, terete above; pedicles 12-20 or more, 15 mm. long; perianth 5 mm. long, dull white with a brown



ALLIUM MONTICOLA (Davidson)

stripe, fading to lavender, segments ovate; stamens widening a little below, exceeding the perianth; stigma not divided; crests 6, crowned with the remnants of a cellular ridge of oblong cells very conspicuous during inflorescence.

No. 3408 type specimen. Abundant on a hill east of Beaumont, *J. C. Marvin,* April, 1921.

This plant has the habit and general appearance of *A. haematochiton* but lacks the numerous blood-red bulb coats of that species. The capsule is markedly different in the two species.

ALLIUM MONTICOLA n. sp.

Bulb ovate, 18 mm. wide without definite coatings; stem 5-10 cm. long stout, terete; leaf single, 6 mm. in diameter, fleshy, terete with a shallow groove at the base, much longer than the stem, in stout specimens sometimes 3 dm. long; pedicels 12 or more, 5-8 mm. long; bracts usually 3, broadly ovate with long acuminate tips; perianth pinkish with brown midribs fading to a deeper pink, segments 13 mm long, 4 mm. wide, lanceolate, acute, the tips slightly recurved, inner segments slightly smaller, stamens 10 mm. long, widening to the base; stigma single; pistil 8 mm. long; capsule obong its pyramidal top crowned with six thin vertical crests.

No. 1924 type specimen from the rocky slopes of Mount Markham, Los Angeles County. June 1921, *R. Kessler;* Mt. San Antonio, *Burlew.*

MYZORRHIZA HUTCHINSONIANA n. sp.

Plant 12 cm. high with thickish root 2.5 cm. in diameter, glandular pubescent throughout; scales rather fleshy, inflorescence thyrsoid; bracts 2, linear, close to the calyx; flowers 2 cm. long; pedicels 3 mm. long; calyx 1 cm. long, divided to the middle, the segments 3 mm. wide at the base narrowing to a blunt tip; corolla tubular, 5 mm. wide contracted at the mouth, white with 2 yellow linear folds on its anterior aspect inside, slightly bilabiate, 2 cleft above, 3 cleft below, the lobes short; stamens glabrous before dehiscence.

Type No. 3407. Palm Springs, *Mrs. W. W. Hutchinson,* April, 1921.

This plant is much more fleshy than *M. californica,* the sepals are shorter and blunter and the white flower is characterized by a somewhat contracted mouth. No plants were growing in its immediate vicinity.

LEWISIA BERNARDINA n. sp.

Root fleshy, globose or conical; leaves 5 cm. long, linear, widening above the middle and narrowing above to the blunt apex; scapes several, 7-8 cm. high; bracts linear, entire, opposite, about 15 mm. from the base; sepals 2, acute, entire; petals 8 or 9, 20 mm. long, 4 mm. wide, apex rounded and apiculate; flowers soliatry and terminal; stamens 12-15, styles 5; scapes not rertocurved in fruit.

CEANOTHUS OBLANCEOLATUS (Davidson)

No. 3425 type, Bear Valley, San Bernardino Mts., May, 1921.

This plant difers from *L. nevadensis* Rob. in the larger number of stamens; the higher positio nof the bracts; the short leaves and the erect fruit. Mr. Jepson in "Flora Cal" in notes and illustration shows the leaves as much longer than the scapes while Dr. Robinson in the "Synopt. Flora" describes them as not surpassing the scapes. Mr. Jepson specifically states *L. nevadensis* does not grow in So. Cal, while Mr. Robinson includes the San Bernardino Mts. among the localities where found.

CEANOTHUS OBLANCEOLATUS n. sp.

Shrub 1 meter or so high; bark greyish, smooth; branchlets microscopically tomentose; flowers white in terminal umbels; leaves oblanceolate, opposite, pinnate-veined, light green and smooth above, paler benea thon account fo microscopic tufts of pubescence between the veins, horns of the capsule 2 mm. long quite close to the top.

Type No. 3412, abundant in the upper part of Bouquet Canyon, San Gabriel Mountains, *Mrs. W. W. Hutchinson,* May, 1921.

This has passed as *C. cuneatus* but is readily distinguished by the shape and lighter color of the leaves. The fruit when half mature is characterized by all the carpels showing as distinct papillae of equal length.

SEDUM NIVEUM n. sp.

Glabrous perennial with rhizomatous roots; stems all erect, 5-7 cm. high, branching from the base; leaves thick, cuneate-obovate, 6 mm. long, 5 mm. wide, 2 mm. thick, convex beneath, leaves alternate, one length apart above; cymes 2-3 forked; sepals lanceolate, about half the length of the petal; petals white, with a light pinkish, median stripe on upper half, 7 mm. long, 3 mm. wide; flowers 15 mm. broad; stamens 10; pistils 5; carpels erect, free at base.

No. 3430 type from north slope of Sugar Loaf Peak, San Bernardino Mts., *R. Kessler,* July, 1921.

One feels like apologizing in adding to the already numerous speceis of Allium but those here described have not only been studied in the field but the majority of them have been cultivated by Mr. R. Kessler and examined in all stages of growth. In the dried specimen if the fruit is nearly mature the capsules split so that it is almost impossible to ascertain the nature of the crests. The shape of the bracts is usually described as of importance in the diagnosis, but they are really of no value in this respect. If the pedicels are long the bracts are long acuminate, if short ovate and less acute, their shape being wholly determined by the length of the pedicel. The length of the pistil is of great differential value, some but 2 mm. long while others are 8 mm. The reticulations on the membranes coating the bulb seem of no value in the determination of our local species as they seem too indefinite.

FURTHER NOTES ON ZAUSCHNERIA. I.

George L. Moxley.

In the description of *Z. pulchella* (S. W. Sci. Bull. i:27-28) the capsular characters were omitted on account of the immaturity of the specimens from which the species was described. Mrs. E. C. Sutliffe, who collected the type specimens, again visited the same region in 1920 and collected quite a quantity of material which it has been my privilege to examine. Some of it is very like the type in every respect, some specimens are more glabrate, and others have a somewhat broader calyx-tube. The variations from the type are, in my estimation, for the most part not sufficient to make them worthy of even varietal mention, being chiefly such differences in pubescence and size of leaf as might result from difference in sunlight or moisture.

In the original description the height of the plant was given as "apparently 1.5 dm. or less." Some of the plants of this later collection are as much as 2.5 dm. high, but most of them are less than 1.5 dm. A few of them have leaves somewhat broader than the type and might be called broadly, instead of narrowly, lanceolate. In one plant the calyx-tube is 18 mm. long and 5 mm. broad at the throat, with sepals 8 mm. long and petals 10 mm. long. The styles are exserted from 5 to 8 mm. In the most nearly typical plants the capsule is from 15 to 20 mm. long, about 3 mm. in diameter, subsessile or very short-pedicellate, conspicuously red-costate, and attenuate to a beak which is usually about 4 mm. in length. The immature seeds are turbinate to oblong, 2 mm. long by 1 mm. thick at the top, smooth or longitudinally wrinkled and minutely glandular.

ZAUSCHNERIA PULCHELLA var. *ADPRESSA* var nov.

Differs from the species in the very much shortened internodes which are mostly less than 1/3 the leaf length, the closely appressed leaves giving the plant the appearance of a narrow, very tomentose strobile. Leaves shaped as in the species but with a much heavier indument. Calyx-tube narrower than in the species and more heavily clothed with stiff white hairs, especially at the tips of the narrow lobes which are obscure in the bud. Calyx lobes 5-6 mm. long, 2 mm. wide. Petals very narrow, 8 mm. long with a sinus 2 mm. deep. Style exserted 5-6 mm., the stamens apparently included. Ovary completely hidden in the closely appressed foliage. Capsule about 15 mm. long, 2 mm. in diameter, fusiform and somewhat falcate, attenuate, red-costate.—With the species, Salmon Lake, Sierra County, California, *Mrs. E. C. Sutliffe,* Sept. 1, 1920. Type in the herbarium of the California Academy of Sciences, San Francisco. Duplicate in the author's herbarium.

ERRATA

In "A Study in Zauschneria" (S. W. Sci. Bull. i:13-29, 1920) a number of typographical errors occurred.

On page 13, third line from the bottom of the page, "Ranksian" should be Banksian.

In the key to the species, page 20, lines 7 and 8 were trans posed. They should have appeared as follows:

Leaves linear-lanceolate to linear-oblong *microphylla* 2.

Leaves lanceolate-oblong, tapering to both ends; flowers small and slender *argentea* 18.

Following the description of *Z. Pringlei* Eastw., page 26, the specimen examined was omitted.

Specimen Examined.

Los Pinitos, Sonora, Mexico, Oct. 12, 1890, 6100 ft. alt., *C. V. Hartman,* No. 144. (UC.).

THE IMMATERIAL BASIS OF HEREDITY

By James R. Allen

It seems quite remarkable that the science of heredity has benefited so little from the wonderful researches, during the last two decades, in the departments of physics and chemistry. It is not putting the matter too strongly to say that, while the brilliant results in the new chemistry of our day have been so startling and far-reaching as to practically revolutionize our customary modes of scientific thinking, the old problem of vital inheritance remains very much the same as it was a quarter of a century ago. Why this should be true, when there is so much new and excellent data at hand with which to place the science of heredity on an entirely new foundation, is difficult to understand. If we would but make good use of the wealth of material with which physics and chemistry now supply us, there is no longer the need, nor excuse, to begin our researches in heredity at a point higher up than the electronic bases upon which has been reared the modern structure of physical science.

The entire problem of vital inheritance rests, primarily, upon the constitution of matter; and our concepts of hereditary units should be in accord with the latest and highest achievements in physical science. Whatever hypothesis we assume as to the constitution of the atom, the same must be employed by the biologist as the basis of heredity; and all our theories to account for persistence of type, or variations therefrom, must be grounded upon and developed out of the hypothetical nature which we accord to the so-called ultimate "material unit."

An epitome of the numerous and remarkable discoveries of the past decade in physical science clearly reveals their revolutionary character and tendency. The general trend of this tendency is, unquestionably, toward immaterializing the essential nature of matter. Nothing whatever exists corresponding to the ordinary conception of a material particle. The "atom" of the science of yesterday has passed into the limbo of the manifestly impossible. The "electronic atom" that has usurped its place is a gross misnomer, and bears much the same relation to the old concept as does a vacuum to the container in which it is enclosed.

The quest for the ultimate material unit is ever abortive and disappointing; and, probably, for the good and sufficient reason that such a thing does not exist. Recent discoveries along this line of inquiry strongly indicate the futility of such a search. It seems like a chase after the fabulous bags of gold at the foot of the rainbow. If scientists were always as good philosophers as they are physicists and chemists, they would have suspected, long ago, that their preconceived notions of what matter must essentially be have painted a mirage across their scientific vision, to mislead and deceive. Philosophically, an indivisible material particle, however minute, is an impossibility. Its size could

in no way affect this principle of rationative necessity. Were the particle, compared with the atom, as a grain of sand to the great Nebula in Andromeda, the human mind must refuse to believe in its indivisibility.

If the descent from the atom to the electron is merely the breaking up of the old hypothetical material unit, and substituting therefor, as an ultimate, a smaller material unit; we are travelling a road that leads nowhere, and which cannot possibly have an end. But the development of the electron theory does not point in that direction, nor lead to such a conclusion. All the evidence favors the assumption that such a thing as an ultimate material unit does not exist. On *a priori* grounds, we were already assured that such is the case, but it is a splendid tribute to the thoroughness of modern physical research that the findings of science tend to confirm the mandates of abstract reasoning.

Professor J. J. Thomson, of the University of Cambridge, perhaps the greatest authority on the electronic theory of matter, is inclined to the opinion that the essential nature of what we know as "matter" is immaterial. His celebrated "vortex theory" blazed the trail in that direction. From it came his own corpuscular theory, and the theory of electrons—all tending in the same general direction.

Altho, seemingly, remarkably consistent and entirely satisfactory in many respects, the splendid structure of the electron theory of today rests upon an unknown terrain. No scientist living can give, even to himself, a satisfactory explanation of the positive electrial content, which, it is supposed, constitutes the conservative, central portion of the atom. We are told that all electrons supposed to be directly involved in chemical changes are negative electric charges; whether the changes be elemental, as in the case of emanations from radio activity, or molecular in the formation of chemical compounds. The number of these negative electrons determine the group-form of their arrangement in the atom, and this arrangement determines the nature or qualities of the element in which the form occurs. The accession to an atom, or the loss from it, of one or more negative electrons may necessitate the re-arrangement of the remaining electrons, thereby changing the fundamental character of the element, suddenly transmuting it into an altogether different element, as such things are judged from reactions in the usual laboratory tests.

In the formation of chemical compounds, the various groupings into which different numbers of electrons must arrange themselves, as well as their different degrees of stability, have been worked out with ingenious scientific precision, and are apparently confirmed by electrolytic experimentations and formulae. Every addition or loss of an electron affects the positive-negative equilibrium, even tho it does not break down the group arrangement If we select a certain atom containing the minimum number of negative electrons necessitating a certain group formation, we find that such an atom may receive a definite number of new electrons before the grouping becomes unstable to the breaking point. On the other hand, if this atom should lose even a single electron, the grouping immediately breaks down, and the remaining electrons rearrange themselves in a new form.

Now, the electron theory would be equally serviceable as a working hypothesis, whether we considered the electron as "material" or not. If we regard these supposed ultimate factors as being "immaterial," the facts would be just as well accounted for; some fundamental difficulties would, doubtless, be overcome; and, moreover, the assumption would have the invaluable additional merit of being in accord with our conviction of rationalistic necessity. An ultimate material particle is unthinkable.

Science has already demonstrated that the one thing indispensable to the existence of matter is *form*—the form-grouping of atomic electrical charges. And these forms certainly do not depend upon the assumption that their content and boundaries are material units. They are as purely formal as the mathematical point and line. They may well be likened to the ideal forms of geometry and of transcendental philosophy. The more thoroughly we understand the foundations of mathematics and philosophy the better will we appreciate this comparison. The science of geometry would lose none of its validity if all matter, insofar as it now yields to measurement, were swept from the universe.

We need not quote any less authority, and perhaps could not quote a greater, than Professor Cassius J. Keyser, of Columbia University, to tell you that mathematics is nothing more nor less than *applied logic*.

When Immanuel Kant tells us that space and time are forms of intuition, he is saying as clearly as he can make language express it that they are not intuitions at all. They are but the *forms*. They are as the moulds of the designer into which the artisan may pour any and all sorts of material. Space and time are the immaterial moulds to which all intuitional empiricism must conform. This Kantian interpretation seems so clear that it would appear needless to remind one of it; yet the president of one of the greatest universities in this country, in a work upon Kant, says, and says without qualification, that Kant tells us that space and time are intuitions.

It is in this purely formal sense that we must regard matter as it really is; and every new stride in physics and chemistry is carrying us nearer such a goal. There is a well-known interpretation of our sense of personal identity that may serve to illustrate the method by which we may better understand the probable nature of matter. The problem here referred to is, how is it possible that we can, and do, throughout life, maintain our sense of personal identity, even when the entire mental and moral constitution has been fundametally changed, and science has conclusively demonstrated that, in the course of every few years, every cell in the body has been renewed? The explanation offered is, that what the cell transmits is simply and solely its *form*; and it is this form, or form memory, that maintains the continuity of personal identity. It is, doubtless, in some such sense that we should regard the nature of what we know as material substance.

The most fundamental fact in the phenomena of heredity is not variation, but persistency of type. It may be granted that the tendency to vary is ever present, and that it is the indisputable foundation of all evolution; but to begin our study of vital inheritance with the phenomena of variation is much like beginning psychological research with the aberrations of the insane and the feeble-minded. As long as we assume that matter is materialistic, there appears no escape from some form or modification of the pre-formation theory, with all the absurdities and irreconcilable contradictions that it entails. Weismann is assuredly right in saying that we can make no progress by the use of material units; but we certainly do not avoid or escape such units by simply beginning our investigations, as he suggested, "at some point higher up." All combinations of such units would still be material, and would be as inadequate as ever to explain the intricate phenomena of heredity. To assume that such things as "ids," "biophores," "determinants," or any other vital factors, under whatever names they may masquerade, are material entities, in the ordinary acceptation of the word, is but to fall into inextricable difficulties; difficulties which Weismann himself seemed to foresee and sought vainly to avoid.

If we assume that the bases of the germ-plasm are material units, there is no escape fgrom the conclusion that the germ-plasm is handed down through an infinite series of successive generations, and in just such form as may be necessary to preserve the continuity of type. It is doubtful whether any biologist really believes such a thing; yet his materialistic assumptions absolutely necessitates such a conclusion.

For want of a better term, we may designate as form-tendency the connecting link between parent and offspring. This form-tendency performs the same office in maintaining the continuity of type as that which Weismann assigned to the selective principle in the germ; but with this added advantage, that, while Wesimann's germinal selection implies some sort of choice, the form impress operates through rigorous mathematical necessity. The phenomena of heredity are subject to the same laws of mathematical necessity as those which govern the various groupings of eletrons that determine elemental qualities. Just as in personal identity the sense is preserved solely through the form relation, so it is in vital inheritance nothing is transmitted but the form necessary. It little matters what names we employ by which to designate the complex groupings and combinations of elemental forms that make manifest thephenomena

of vital inheritance. The chief point is, that they are type ideals, transmitted and preserved solely through the form relation.

The objection may be urged that any condition, which with rigid exactness preserves the continuity of type, precludes the possibility of variation, upon which tendency all evolutionary development denpends. Such criticism, however, overlooks the fact that the form-tendency which expresses itself in the phenomena of variation is ever present in the species as a characteristic of the type, and may remain latent and unmanifested indefinitely, if favorable conditions do not arise to induce its expression. The form-tendency to vary falls under the same mathematical law as the preservation of type. No mathematical principle could be more rigorous. Every parabola, or hyperbola, is an illustration of the necessary and inflexible order of hereditary deflection.

The specialized forms directly concerned in heredity may be regarded as combinations of elemental electronic groupings. It may well be, therefore, that these higher, synthetic forms are subject to laws similar to those which govern electronic charges, varying in stability, breaking down suddenly, and re-combining in a new group formation. If the conditions and processes determining the form-character of the factors in heredity are but extensions and vital adaptations of laws governing elemental electronic phenomena, the origin of species by mutation, or saltation, is just what we should expect. The occasional appearance of a "sport" in the direct line of inheritance would indicate that the number of group-units constituting the character-form had been, perhaps slightly, increased or descreased, when the formation was already at a high state of instability. The sudden breaking down of the ancestral formation and the re-arrangement of the constituent parts in a new form, indicate the same processes that are observed in electronic phenomena.

If we closely follow the electronic analogy, the suddenly created new character, or new species, would be extremely unstable relative to one of two possible conditions. If the critical number of units necessary for the new grouping was obtained by the addition of a single unit, the new character would be extremely unstable relative to any loss therefrom; for, in that case, the loss of a single unit would result in the sudden extinction of the new character, and the reversion to the ancestral form. The entrance of additional units would continue to increase the stability of the new form up to a certain point, beyond which, if the process of addition continued, the stability would decline to a new breaking point.

On the other hand, if the new character resulted from the loss of a single unit from the ancestral form, the new creation would be subject to the exact reverse of these conditions. The loss, then, of one or more units would render the form more stable up to a certain point, after which, were the process continued, the stability would decline to a new point of dissolution. This form, however, could not receive a single additional unit without breaking down and reverting to the ancestral character.

When a character created by unit addition breaks down through the continued increase of its constituent units; or when a character resulting from unit loss suddenly disappears through the reverse process; the new character which then arises is something essentially different from the parent "sport," and from their common ancestor.

If, in cultural propagation, it is desired to maintain fixedly a certain sport character, it is necessary that the form be kept as nearly as possible at its highest point of stability. What this point, in any given case, may be, and what may be the best methods by which to reach it, are in the very nature of the case difficult to determine. Careful experimentation, however, might determine whether its stability is on the side of unit addition or unit loss. In either case, cross-fertilization in a certain direction, if selection is wisely made, may secure increased stability. In the absence of anything better, direct-line breeding may keep the character fixed; but in such case it should always be remembered that the character is stable from one side only, and always extremely unstable in the other direction. Possibly, through selective propagation only, a unit may occasionally be added to or taken from the character form to increase its stability; but in no case can such a process continue indefinitely,

or even very long, in the same direction, without bringing the form to a new point of sudden dissolution. In no sense, however, is stability ever absolute, and even in strictly line propagation an occasional sport character from a parent sport is to be expected.

The assumption that the vital processes in heredity follow the same law that govern electronic phenomena would lose none of its logical consistency or cogency, in whatever light we may regard the nature of the electron. Were the electron the ultimate, indivisible, material particle that we once supposed the atom to be, it would in no wise lessen the demand upon us to seek the interpretation of vital phenomena through the use of the principles underlying electronic activity. The pathway of science is strewn with the wrecks of "good working hypotheses." The theory that "seems to account for all the facts" is often more deceptive and dangerous than one that flaunts in our face its obvious contradictions and impossibilities. The mathematician must frequently deal with an equation yielding two very different but equally correct results. The scientific hypothesis that leaves no crevice for an exception or denial may be likened to one of the answers to such an equation. Some other very different hypothesis—possibly any one of several—might serve equally well to account for the observed phenomena. We should demand more than this from every scientific theory. One of its chief merits should be its high degree of plausibility. It must meet the inexorable demands of rationalistic necessity. Whatever other merits it may possess, the theory that is fundamentally illogical cannot survive, however well it may appearently account for all the facts.

The biology of the future will occupy and utilize the immense field opened up for it by the electronic theory of matter. Late researches in physics and chemistry offer the student of heredity opportunities never before available; and which, if wisely utilized, will do more to introduce scientific precision into the study of vital phenomena than has ever before been accomplished in the entire history of biological inquiry.

The observed fact that ontogenetic development is an epitome of phylogenetic evolution, is seen in a new light of mathematical necessity, when the formulae of electrolytic experimentation are introduced into the domain of operative vital factors. Apply the electronic methods of the laboratory to the problems of heredity, and the mystery enveloping the genesis of variation disappears, and the sudden appearance of new forms is seen to be the natural and inevitable results of exact mathematical laws. Electrolytic chemistry has already determined these laws for electronic action; now, let us simply extend their application and operation into and throughout the field of vital inheritance.

James R. Allen

San Fernando, Cal., June 23, 1921.

THE DIAMETER OF a ORIONIS BY MICHELSON'S INTERFEROMETER METHODS

By F. G. Pease

(Courtesy Popular Astronomy)

In 1890 Michelson pointed out the possibility of measuring by interference methods, the diameter of planetoids and satellites and the distance between double stars, and also showed how the method might be used in determining the diameter of a star.

He measured the diameters of Jupiter's satellites with the 12-inch Lick refractor in 1891, and in August, 1919, obtained interference fringes with the 40-inch refractor of the Yerkes Observatory, and with the 100-inch reflector at Mount Wilson in September of the same year. In December, 1919, and the months following, Anderson obtained measures of the distance and position angles of the components of Capella with great accuracy. At Professor Michelsons suggestion, an interferometer beam 20 feet long, provided with movable auxiliary mirrors, was then constructed to test conditions of interference at distances greater than the diameter of the one hundred-inch mirror itself. In August, 1920, fringes were obtained with separations of the mirrors as great as 18 feet, the visibility of the fringes for Vega at this distance being as great as that at 6 feet.

Meanwhile, Eddington, Russell and Shapley had obtained values for the diameter of a number of stars based on estimates of apparent surface brightness, and their results indicated that several of these lay with the range of the 20-foot beam. Orionis in particular was so large that Merrill investigated it with the apparatus used in the measurement of Capella and found a definite decrease in visibility for the maximum separation of the slits, (100-inch aperature), this holding true for all position angles.

On December 13, 1920, with the outer mirrors of the 20-foot beam at 121 inches separation, no fringes were visible on *a*Orionis,, while observations on *r*Orionis before, and on *a*Canis Minoris afterwards yielded strong fringes with practically no change of setting. All measures were checked by Dr. Anderson. The seeing was very good on this night, but poor on the following nights, and it appears that better conditions are required than when working with fringes produced by apertures placed directly before the telescope. Nevertheless observations made December 14-17 indicate that *a*Ceti, *a*Tauri *and* *b*Geminorum will come within the range of the 20-foot beam.

Assuming that the effective wave-length for *a*Orionis is *r*5750 its angular diameter from the formula $a=1.22\ r/d$ proves to be 0" .047, and with Schlesinger's parallax of 0" .016 its linear diameter turns out to be 271,000,000 miles or slightly less than that of the orbit Mars.

The uncertainty of the present measurement is about 10 per cent. The effect of a possible darkening at the limb, which has been disregarded, would tend to make the measured results too small.

INTERESTING FACTS ABOUT OUR OWN PLANET

By Charles Nevers Holmes

An equatorial journey "around our World" equals a distance approximating 24,900 miles—a distance crossed by light in less than 2/10th of a second, which would be traveled by a snail in about 34 years. Now, the Earth rotates once upon its axis in 24 hours, so that at a velocity approximating 24,900 miles per day a point on the equator would travel during the 20th Century about 909,000,000 miles. That is, it has traveled since the beginning of the Christian Era about 17,500,000,000 miles, or a distance equal to 188 times as far as it is to the Sun.

A journey to the centre of our Earth would approximate 3959 miles, and if we should ever sink a shaft there, excavating at the rate of 10 miles a year, it would take 4 centuries to reach the terrestrial centre. Now, 3959 miles do not seem very far, the extreme length of the United States, Atlantic to Pacific being about 2800 miles, and the extreme length of North America being about 4500 miles. However, if we attempted to tunnel downward to the terrestrial

centre, we should encounter stupendous difficulties of heat and pressure. It has been estimated that the temperature of molten lava ranges from 1200 to 2000 degrees, Centigrade, and it has also been estimated that at the Earth's centre the density may be as great as ten times that of water, resembling some very heavy metal. Therefore, it is improbable that during the present century we shall begin any tunnel to the terrestrial centre, although the time may be at hand when we shall sink deep shafts to tap and utilize the heat and other energies now hidden beneath our World's surface.

There is, however, an interesting fact about a shaft sunk from the surface to the centre of the Earth. As we all well know, each of us possesses what is called "weight," due to the attraction between the Earth and our body. For example, one of us weighs "150 pounds" at the Earth's surface. If this individual could be weighed at the Sun's surface, he would weigh more than two tons! If at the moon's, only 25 pounds. The reason for this difference in weight is, that surface gravity varies according to the respective weight and size of the Earth, Sun and Moon. Moreover, a man weighs "150 pounds" in one region of the Earth, and slightly less than that on the equator, inasmuch as at the equator the entire centrifugal force is pulling against the force of gravity. If a shaft could be sunk to the terrestrial centre, and a man weighing "150 pounds" should be lowered within it, this man would weigh only "112½ pounds" at about 1000 miles below the surface. That is, he would lose one-quarter of his weight after descending one-quarter of the distance to the centre. Then, after descending one-half of the distance to the Earth's centre, he would weigh only one-half of "150 pounds." If this man reached the very centre of the Earth, he would have no weight at all. The explanation for such losses in weight is that at the terrestrial surface this man is drawn towards the terrestrial centre by full gravitative attraction, whereas, as he descends below the Earth's surface, it is as though he were standing upon the surface of a smaller Earth, which would shrink, in size and decrease in gravitative attraction in proportion as he approaches its centre. Accordingly, if this man could reach the exact centre of our Earth, there would then exist, no more gravitational units to attract his body. Surrounded by a terrestrial sphere approximating 260 billion cubic miles, his surface "weight" of 150 pounds would become a veritable cipher.

Nevertheless, although this man at the terrestrial centre has no weight himself, the Earth all around him has a stupendous weight. The man who once weighed "150 pounds," would be surrounded by a vast sphere, averaging a radius of 3959 miles in every direction. Inasmuch as the diameter of the Moon is only 2163 miles, it is evident that he could be surrounded by a number of such moons, each moon being equidistant about 898 miles from both the Earth's centre and surface . Therefore, it should not cause any surprise that the Earth is 49 times as large as its satellite the Moon. However, the weight of our Earth may cause some surprise—6,000,000,000,000,000,000,000 tons! Of course this is a mere cipher compared with the weight of the Sun, but, if we multiply this weight by 2000, or the number of pounds in a ton, we find that the Earth's weight approximates 12 septillion pounds. Possessing such a comparatively stupendous weight, our planet is able to chain us securely to its surface, and if we try to escape from that surface it ofttimes dashes us violently to the ground. The influence of its mighty mass is seen alike in a body's falling 16 feet during the first second, 64 feet during the first two seconds, and in the fact that, to escape forever from its surface, a body must rise with a velocity of not less than 37,000 feet per second.

The Earth's 12 septillions of pounds are contained within a vast sphere possessing a bulk of about 260 billion cubic miles. Enclosing this vast sphere, there is a surface-area approximately 197,000,000 square miles. Upon this wide surface-area there dwell about 1,700,000,000 people, which would be an average of more than 8 people for each square mile of total surface, an average of about 30 for each square mile of land surface, and an average of about 561 people for each square mile occupied by the United States. Today the density of population in our 48 states averages about 35 citizens, per square mile. From the District of Columbia, which has more than 5,500 inhabitants in a square

mile to the deepest depth in an ocean, the Pacific, 32088 feet, the distance is over 9000 miles. From Washington, D. C., to the highest height on the Globe, Mount Everest, 29,002 feet, the distance is more than 9000 miles. From the deepest depth in an ocean to the highest heigh on the Globe, there is an altitude of 61,090 feet, 11.6 miles. If we remov our "150 pound man" from the Earth's centre and place him at the very bottom of the Pacific Ocean, his body will be under the terrific pressure of at least 13,500 tons. If we place this man upon the summit of Mount Everest, he would then be under a pressure of approximately only 5 tons.

A cubic foot of sea water has a weight of 64.3 pounds, and, accordingly, we should not be surprised that a man's body, placed at the very bottom of the Pacific Ocean, 32,000 feet below its surface, would be crushed to a pulp by the pressure of water. At the surface of the sea there is an atmospheric pressure of 14.7 pounds upon every one of the 2000 square inches covering a human body, so that there our "150 pound man" would be surrounded by a total individual pressure of more than 14 tons. Fortunately, however, this exterior pressure inward is counteracted and neutralized by an equal interior pressure outward, for, otherwise, our bones would have to be stronger and harder to resist the atmospheric pressure. This atmospheric pressure becomes less and less as we ascend above sea level, and it is probable that the terrestrial atmosphere does not extend higher than 300 miles. However, our atmosphere approximates a volume of 60 billion cubic miles and a total weight of almost 6 quadrillion tons.

If we were able to ascend above our atmosphere and escape from the Earth, we should experience another interesting fact. It has already been stated that if we could descend far below the terrstrial surface, we should lose "weight" directly as the distance. That is, at one-fourth of the distance of the terrestrial centre, we should weigh only three-quarters of what we did at the surface, at one-half of the distance only one-half, and at the very centre we should possess no weight at all. Now, if we were able to ascend far above the terrestrial surface, we should find that we lose weight according to the square of the distance, inversely. Since the distance from Earth's surface to its centre is about 4000 miles, then if our "150 pound man" could ascend 4000 miles aobve that surface, he would weigh only ¼th as much as he did at the surface. For, having ascended 4000 miles, he would be twice as far as he was from the terrestrial centre, inasmuch as 8000 miles are twice 4000. Therefore, he would weigh ¼th of of 150 pounds, or 37½ pounds. If he rose 8000 miles above the terrestrial surface, he would be 12,000 miles from the terrestrial centre, thrice as far, since 12,000 miles are thrice 4000, and, accordingly, he would weigh 1/9th of what he did, or 16 2/3rds pounds. Moreover, if he left the Earth 240,000 miles behind him, he would still possess some weight. This distance would be 60 times the Earth's radius, and, therefore, his weight would be diminished to 1/3600th of his terrestrial weight—a little more than 4/100ths of a pound. Now 240,000 miles are about the mean distance of our Earth from its Moon, and it is evident that 4/100th of a pound, about 2/3rds of an ounce, represent the influence of terrestrial gravity upon our "150 pound man," were he placed on the lunar surface.

There are many, many more interesting facts about our Planet, many of which are discovered "under the microscope." One of these other facts is discovered "through the telescope,"—the indescribable minuteness of our Earth compared with the indescribable vastness of the Universe. Our own "local Universe" is bounded by the so-called "Milky Way," and the distance across it, the diameter of the "Milky Way," has been variously estimated, one of these estimates approximating 6 quadrillion miles. If this estimate is correct, our planet, compared with our "local Universe," resembles a veritable pea situated within a circular area, an area so vast that it would take an aeroplane speeding 100 miles an hour approximately 70 million centuries to fly across it!

THE EXCEPTIONALLY HIGH SOLAR PROMINENCE OF OCTOBER 8, 1920

(POPULAR ASTRONOMY)

By Oliver J. Lee

This paper presented some of the results gotten from a study of the fifty-seven photographs obtained of this eruption. The crest attained the highest altitude so far recroded, 531,000km, or more than 19′. Photographs were exhibited showing the early stages in the development of the structure, in particular how the various degrees of separation of the head from the base took place. The highest velocity observed was 155 km/sec. Several cases of peculiar motion were studied. The separation of the head into parts which continued the upward course unchecked and other parts which reversed their motion and fell back upon the sun is especially noted.

ON THE AGES OF THE STARS

By F. R. Moulton

Attempt was made to get some idea of the duration of the stars from dynamic consideration of the globular clusters. Their symmetrical distribution, which in many cases follows approximately the same law, implies that they have arrived approximately at a steady state through a long dynamic evolution. It is reasonable to suppose that this evolution has taken place during the life of the stars of which the clusters are composed.

The period required for a single circuit of a star through a globular cluster is of the order of a million years. The dynamic evolution results primarily from the occasional near approaches of stars. It is found that on the average a star would make several thousand revolutions before it would pass near enough some other star to change its direction of motion from that which it would otherwise have by so much as ten degrees. Consequently it is inferred that the arrangement of the stars in globular clusters points to the conclusion that the stars of which they are omposed are several thousand million years of age.

WHEN AN ECLIPSE PREVENTED A WAR

(Popular Astronomy)

By William F. Rigge

From an Indian village near the present town of Lisbon, North Dakota, a great war party set out one day. After they had been out for a short time, the sun was blotted out in full day and the party became so terrified that they fled precipitately back to the village. The question asked of the astronomer by the historian was: When did this eclipse occur, and was it a total one? The answer was that it happened in 1724 on May 22 at 11:04 A.M. Central Time, and that the obscuration was 96.4 per cent. See Popular Astronomy for June-July, 1920.

THE PRESIDENT'S MESSAGE

The result of the work of the year ending June 1st, 1921, has been most gratifying to the members of the Academy who have watched the progress made during the time above specified.

Our membership has more than doubled in that time and the directors of the Academy have shown their appreciation of the work done by assuring the officers of their entire support during the coming year.

Our present membership is a little over 300 and we shall not be satisfied with anything less than a one hundred per cent gain during the year ending June first, 1922.

The results of the year are not due to any one person but to a singleness of purpose that has resulted in effective team work. Some of the older members tell me that this is the first time in the history of the academy that the membership has doubled in a single year.

Beginning with the issue of this bulletin there will be offered the advantage of a service in which we undertake to answer as fully as possible any and all questions upon scientific subjects.

Any person, whether a member of the Academy or not, will have prompt and courteous response to any request for information upon any scientific subject by addressing the president at 530 Auditorium Bldg.

To inquiries which the president feels competent to answer he will reply directly. Other questions will be referred to specialists in the various branches of knowledge as geology, paleontology, botany, entomology, aeronautics, seismology, electricity, psychology and the like.

We are fortunate in having in our membership men of wide experience and recognized ability in their special lines and they are cooperating with us fully so that we confidently expect good results in this new phase of our work.

In the hope of rendering practical service to the younger people of our communities we have invited them to join the Academy and about forty have availed themselves of the opportunity.

We are offering special rates to the Boy Scouts and Camp fire Girls and any who wish to take up the work will be charged only $2.00 instead of the regular annual fee of $3.00. The Camp

Fire Girls in Santa Monica have been particularly far sighted in this matter, about thirty having become members. We shall do something special for them this year.

For some months notices of the meetings have been circulated among the different Boy Scout groups in Los Angeles. Mr. E. B. DeGroot the head Scout Master, approves our plan and advises the Scout Masters, with their troops, to attend the meetings.

During this year and next the Academy will supply speakers on nature study, woodcraft, first aid and kindred subjects at such times and places as Mr. DeGroot shall suggest.

Now, to more completely fulfill our obligation to these young people and more fully stabilize the life and growth of the Academy, we have planned to take special pains with anyone who may wish to acquire the ability to speak in public upon scientific subjects. Good public speakers are rare though we need many of them.

A committe consisting of five experienced men has been appointed who shall take pleasure in consulting with any who may aspire to the scientific platform. This committe will consider questions of topic, subject matter, construction, reading of manuscripts and oral delivery and any other necessary phase of the work.

As soon as anyone shall show himself reasonably competent he will be given an opportunity to demonstrate his ability and so begin his career of usefulness in the scientific world. He will be sponsored by the committee, who, in turn, have the confidence of the entire Academy.

The branch of the Academy organized in Santa Monica in Dec. 1920 has shown remarkable vigor and now has about sixty members. We have had a lecture on the first Monday night of each month in the City Hall and the meetings have all been well attended.

We are now planning to organize branches in Pasadena, Long Beach and other nearby cities.

The enthusiasm now being shown among the members is very gratifying and the splendid spirit of cooperation is bringing results such as we have not seen for years.

One special reason for this is that we now have before us a very special objective in the prospect of the erection of a new and ample home for the Academy—one in which we can house the many treasures which we now have and those which we shall soon acquire in botany, zoology, paleontology, geology, astronomy, and other branches—a place where we can have an adequate and permanent lecture room in which there shall be the best possible projection machines for showing scientific educational films.

This is an objective worth while and we are determined to reach it—sooner, perhaps, than many of us realize.

This year the Academy is offering three prizes, one of twenty five dollars, one of fifteen dollars and one of five dollars for the three largest lists of new members between September first and June first, 1922. This contest is open to all members.

In the president's office there is being kept a record of each new member and the person securing said member is being given credit therefor.

We can do anything we really wish to do—let us have a thousand members by June first, 1922.

F. C. CLARK.

JUNE 1920—JUNE 1921
ANNUAL REPORT OF THE SECRETARY

A resume of the activities of the Academy for the past fiscal year discloses a period of marked expansion. The Directors have held eight special meetings during the period embraced by the annual June meetings of 1920-1921. There has been transacted a wide range of business, all of which has accrued to the advancement of the Academy's interests, and the detailed records of which are properly recorded in the Minutes.

The loss of two of our most able Directors, (Mr. George H. Beeman and Mr. William L. Watts) has been recorded in the "Bulletins" of past issue. Three of our valuued councilors in the persons of Mr. Arthur B. Benton, Dr. Triumph C. Low and Mr. Holdredge O. Collins felt the necessity of resigning their directorships as a result of the heavy demands on their time in other directions, and like justifiable reasons. The vacancies thus caused by death and resignation were filled by the election of

Mr. J. O. Beebe.
Dr. Ford A. Carpenter.
Dr. Frank C. Clark.
Mr. George R. Crane.
Dr. John A. Comstock.

Our valued Secretary, Mr. George W. Parsons, asked to be relieved of the post which he had been ably filling at much personal sacrifice, and Dr. Comstock was subsequently elected to the office.

The active influence of the Academy has been projected to outlying territory through the organization of a branch in Santa Monica.

Three issues of the Bulletin have been published and widely circulated during the year, thus carrying the educational program of the Academy to far and foreign fields.

The lecture programs have been carried on through the various actions, there being only two lectures held by the Academy proper during the year. The first of these was an admirable address by Dr. Barton Warren Evermann on the subject of "The Educational Value of Natural History Museums", held in the Chamber of Commerce on Thursday evening, April 14th. The second lecture was held on the occasion of the annual meeting in July. This was not as fully attended as the worthiness of speaker and subject would warrant. Dr. B. R. Baumgardt's lecture on "Through Shakespeare's and Wordsworth's England" would grace the largest auditorium that any community could offer.

The Directors for the fiscal year, as elected at the annual meeting in June, 1921, are:

Dr. Mars F. Baumgardt.
Mr. J. O. Beebe.
Dr. Ford A. Carpenter.
Dr. Frank C. Clark.
Dr. John A. Comstock.
Mr. George R. Crane.
Dr. Anstruther Davidson.
Mr. Samuel J. Keese.
Mr. George W. Parsons.
Mr. Theodore Payne.
Mr. William A. Spalding.

Following the annual meeting a special Directors meeting was called in accordance with established rule, and the following officers were elected:

President, Dr. Frank C. Clark.
1st Vice-President, Dr. Mars F. Baumgardt.
2nd Vice-President, Dr. Anstruther Davidson.
3rd Vice-President, Dr. John A. Comstock.
Secretary, Dr. John A. Comstock.
Treasurer, Mr. Samuel J. Keese.

TREASURER'S REPORT
FISCAL YEAR ENDING JUNE 22, 1921

RECEIPTS:

Bank Balance June 2nd, 1920	$ 363.89
Dues	896.10
Interest	638.73
Returned from Research Expense	82.98
Freight Rebate on South Sea Collection	99.54
Fidelity Savings and Loan	1,100.00
Mr. Parish—Bulletins	6.00
	$3,187.24

DISBURSEMENTS:

Bulletin Expense	$ 715.39
Lecture Expense	347.30
Office Expense	73.35
Research Expense	1,350.00
Sundries	89.75
Freight on South Sea Collection	99.54
Total Disbursements	$2,675.33
Cash in First Nat'l Bank June 22, 1921	511.91
	$3,187.24

INVESTMENTS ACCOUNT BALANCES:

Mortgage Guarantee Bonds @ 5¾%	$ 5,200.00
Fidelity Savings & Loan Stock @ 6%	2,000.00
3rd Liberty Loan @ 4¼%	2,650.00
4th Liberty Loan @ 4¼%	200.00
	$10,050.00

BIOLOGICAL SECTION
SOUTHERN CALIFORNIA ACADEMY OF SCIENCES

Secretarys Report for season 1920-21

Beginning the season September 23rd, 1920, and closing June 23rd, 1921, the Biological section held ten public meetings at which lectures were given on various scientific subjects as follows:

Sept. 23, 1920; Lecture by Dr. John Comstock
"Protective Mechanisms in Nature"

Oct. 28, 1920; Lecture by Dr. Edwards
"Deep Sea Life"

Nov. 25, 1920; Lecture by Mr. Szymanowski
"The Slavish People"

Dec. 23, 1920; Lecture by J. O. Beebe
"The Story of King Coal"

Jan. 27, 1921; Lecture by Dr. F. C. Clark
"Whales"

Feb. 24, 1921; Lecture by O. G. Jones
"Is Life Electricity"

Mar. 31, 1921; Lecture by Dr. Mars Baumgart
"The Latest from The Heavens"

Apr. 28, 1921; Lecture by J. O. Beebe
"Early Marine Life"

May 24, 1921; Lecture by Dr. F. C. Chandler
"Acidosis, A Living Death"

June 23, 1921; Lecture by Dr. F. C. Clark
"Evolution of Man"

The attendance at these lectures and the interest manifested has been most gratifying and gives great encouragement to those in charge of the work, who wish ardently to extend the popularity of scientific studies. High mark in point of attendance was reached on Oct. 28, when 244 people attended the lecture by Dr. Edwards. For the whole season the average attendance was 136 and as an indication of the progress of the work, it should be observed that the average attendance for last season was 69, showing an increase of almost 100%.

A synopsis of all these lectures has been written in the minutes and several of them have been reported in extenso and revised by the lecturers themselves, these latter include:

"Protective Mechanisms in Nature"
"The Story of King Coal"
"Is Life Electricity"
"Acidosis, a Living Death"
"Evolution of Man".

One feature of the work of the Biological section which has been greatly extended during the past year is the distribution of Postal cards and non-postals, containing announcement of the lec-

tures. An average of about 700 have been printed and distributed for each lecture which indicates that one person has attended for each 6 cards distributed. Perhaps if a little more personal interest were shown by those sending out these cards, better results might be secured.

Any person wishing to receive these announcement cards regulary may secure them by sending a request to the Secretary.

Those who are sufficiently interested to wish cards to mail to their friends, signed by themselves, thus making it a more personal invitation, will be gladly supplied with any number they can so use.

Let's all get busy and boost these popular lectures on Science and next year we will be able to again report a 100% increase in both attendance and membership as well as a far more widely diffused knowledge of the truth regarding the phenomena of the universe by which we are surrounded and of which we form a part.

H. AITKEN, Secretary
336 West 52nd St.
Los Angeles, Cal.
Phone: Vermont 5231

BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Volume XX Part 3

December, 1921

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Los Angeles, Calif.

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A Study of the Noctuid Moths of the Genera

LAMPRA, Hbn. and CRYPTOCALA, Gen. nov.

BY

FOSTER H. BENJAMIN
Assistant Entomologist
State Plant Board of Mississippi

Issued December, 1921

SOUTHERN CALIFORNIA ACADEMY OF SCIENCES
Los Angeles, Calif.

THE AUTHOR wishes to acknowledge with thanks the very valuable assistance given him by the following gentlemen—assistance which made this work possible:

To DR. WILLIAM BARNES, Decatur, Ill., who unconditionally turned over to the author his entire entomological resources; collection, with specimens carefully matched to the types of almost every species considered, by himself, DR. J. MCDUNNOUGH, and SIR GEORGE HAMPSON; laboratory; personal notes; and unpublished manuscripts. Unless otherwise stated, all specimens examined are in the Barnes Collection.

To DR. A. W. LINDSEY, Decatur, Ill., for his personal assistance and suggestions.

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To DR. JAMES G. NEEDHAM, of Cornell University, under whose kind jurisdiction this paper was written.

LAMPRA, Hbn.

Lampra, Hubner, Verz., 221, 1822. *Fimbria* sole species and therefore type.

Euschesis, Hubner, Verz., 221, 1822. *Janthina, unxia, clotilda.* Hampson, Cat. Lep. Phal. B. M., IV, 622, 1903. Cites *janthina* as type.

Rynchagrotis, Smith, Bull. U .S. N. M., XXXVIII, 8, 13, 1890. *Cupida* designated type (p. 9).

Abagrotis, Smith, Bull. U. S. N. M., XXXVIII, 9, 49, 1890. *Erratica* sole species and designated type (p. 9).

Triphaena, Hampson (not Hubner), Cat. Lep. Phal. B. M., IV, 622, 1903. *Interjecta* cited as type.

A STUDY OF THE NOCTUID MOTHS OF THE GENUS LAMPRA, HBN.

The genus Lampra embraces those Noctuid moths of the Agrotinae, with unspined fore tibia, mid and hind tibia spined, smooth front, eyes neither hairy nor ciliated, abdomen flattened, and with head and thorax clothed with hair and scales.

This is the Genus Triphaena of Hampson (Cat. Lep. Phal. B. M., IV, 622, 1903) by reason of his first species idea of selecting genera, but it must sink to Curtis' restriction (Curtis, Brit. Ent., Lep. 1, 348, 1831) with *pronuba* as type. *Pronuba* has been quite correctly placed by Hampson in the genus he calls Agrotis (Cat. Lep. Phal. B. M., IV, 363, 387, 1903); as shown by a personal examination of two specimens in the Barnes Collection, two specimens in the author's collection and one specimén of var. *innuba* in the author's collection. The fact that the type of the genus Agrotis, Hbn. is *segetum,* which has a frontal prominence allying it to Euxoa, is of no concern here.

The genus Lampra, Hubner, Verz., 221, 1822 must stand; as *fimbria* is the sole species and therefore type.

It may be well to note that this is the same view taken by Mr. Grote in his "List of N. A., Eupterotidae, Ptilodontidae, Thyateridae, Apatelidae, and Agrotidae," Abh. Nat. Ver., Bremen, XIV, 44, 1895.

Specimens of the European species of the genus Lampra were obtained from Messrs. Staudinger and Bang-Haas, Blasewitz, Dresden, Germany, and are now in the author's collection.

The main differences between *fimbria* (type of the genus Lampra) and *cupida* (type of the genus Rhynchagrotis) are as

follows: *Fimbria,* size large, secondaries yellow and black, 2nd joints of palpi scaled clavate, 3rd joints porrect, four rows of spines on the hind metatarsi. *Cupida,* size moderate, secondaries fuscous, 2nd joints of palpi triangularly sealed, 3rd joints porrect but somewhat triangularly scaled, three rows of spines on the hind metatarsi. Thus at the outset it would seem that Lampra might be retained for the European species and Rhynchagrotis for the American species. However, it is inadvisable to base genera on color characters, and they are the only stable characters separating the European from the American species. All other characters fail, because in *janthina* the spines on the hind metatarsi are reduced to three rows and part of a fourth, the insect is even smaller than the average *cupida,* the black areas on the secondaries are greatly increased and the 2nd palpal joints are less clavate than in *fimbria.* The only remaining European species, *interjecta* has but three rows of spines on the hind metatarsi, and the second joints of the palpi are more or less triangularly scaled, similar in all respects to *cupida* except in the color of the secondaries and that the third palpal joints are not quitė as triangularly scaled. The difference in the palpi is not great.

Genitalically the European species comes nearest to the North American Brunneicollis Group, which they strongly resemble in simplicity of structures.

Smith included in his genus Rhynchagrotis, two species with yellow and black secondaries, viz: *gilvipennis,* Grt. and *chardinyi,* Bdv.

Hampson separates these from his genus Triphaena because of the rounded abdomen, (Capt. Lep, Phal. B. M., IV., 648, 1903) and places them in "Rhynchagrotis, Smith." He cites the reference for this genus as, Bull., U. S. N. M., # 38, p. 13, and this has led him to an error, for following page 13 is *gilvipennis,* which Hampson takes as type; erroneously cited as *chardinyi.*. Smith definitely designated *cupida* as his type of Rhynchagrotis on p. 9 of the same work.

That Smith did not like this restriction of his genus is apparent from his last paper on this group, published in Can. Ent., XL, 221, 1908. At any rate, the genus has to fall to Lampra and cannot be retained even as a subgenus. As the bodies of *gilvipennis* and *chardinyi* are quite different from those of the normal species of the genus Lampra, they apparently need a new genus which is hereby designated as Cryptocala with the type *gilvipennis,* Grt.

Most authors of the present day agree that in Lepidoptera at least, sexual characters should not be used to designate genera. Therefore, Abagrotis, Smith (Bull., U. S. N. M., XXXVIII, 9, 49, 1890) will sink before Lampra, Hbn. (Verz., 221, 1822); but may be retained as a subgenous with *erratica* as type.

The following subgenera are suggested based on antennal characters of the males.

Abagrotis, Sm., Bull., U. S. N. M., XXXVIII, 9, 49, 1890; having antennae serrate and fasciculate with type *erratica,* Sm.

Lampra, Hbn., Verz., 221, 1822; having simple antennae, with cilia varying in length and sparcity. It is this subgenus which will include all of the benus Rhynchagrotis of Smith; with the exception of *chardinyi,* Bdv., *gilvipennis,* Grt., *bimarginalis,* Grt. and *alcandola,* Sm. As compared with Triphaena, Hamp. nec. Gn., it includes all species with the exception of *chardinyi, gilvipennis,* and species herein listed under the subgenus Abagrotis.

Because of the scattering of original descriptions throughout various, almost unobtainable works, the author has seen fit to republish them, punctuation perfect.

Under each species will be found a bibliography of that species. In this the author has, in the main, followed Smith, Bull. 44, U. S. N. M., and various later writers. With species as closely resembling each other as they do in this genus, it is impossible to guarantee the correctness of the determinations of the various authors. Where mistakes are known they will be corrected and noted under the various species in the text.

Key to Subgenera

I.—Antennae of ♂ serrated..*ABAGROTIS*
II.—Antennae of ♂ simple, ciliated ....*LAMPRA*

Unfortunately, these subgenera are based purely on antennal characters of the males, but the following notes may help to separate the females to the proper subgenus.

Abagrotis—collar always concolorous with the thorax in *ornata, erratica,* and *alcandola.* Markings usually clean cut in appearance in *ornata* and *erratica.* A vertical undivided longitudinal ridge on collar and prothorax of at least *ornata, erratica,* and *alcandola;* and absent or divided in all species of Lampra. The only confusion that can arise with the remaining species of Abagrotis *(bimarginalis)* is in its superficial appearance to *L. vittifrons.* It can be readily distinguished by its costal margin being buff instead of the usual creamy white of *vittifrons;* besides it is normally larger in size; and with the markings more obscure. Its secondaries have a tendency to be fuscous; whereas most of the *vittifrons* have the secondaries very largely pearly white with merely the veins fuscous and a few fuscous scales near the margins. Another character that may hold good or may not is that *vittifrons* has a collar of the same general color as the costal margin of the primaries, whereas in *bimarginalis* the collar is deeper in color than the costal margin, and in one specimen examined has considerable gray scaling. It may be that this insect has a thoracic crest similar to the other species of the subgenus, but only three specimens were available and all of these somewhat rubbed. One specimen from the Neumoegen Collection showed traces of a distinct crest.

SUBGENUS ABAGROTIS, Sm.

This subgenus is characterized by the serrate and fasciculate antennae of the males and in having a distinct keel-like ridge on the collar and prothorax (with the possible exception of *bimarginalis*).

The species seem to be in a relatively stable state of evolution, being well defined genitalically; as far as our present knowledge of them holds true.

The species *hero,* Morr. has been sunk as a synonym in the Brunneicollis Group as explained under that name.

Superficial Key to Abagrotis Sp.

I.—A contrasting buff costal margin............................*bimarginalis*

II.—Not so.

A.—Subterminal line and transverse posterior line approximately parallel throughout (except at *extreme* costal margin; ....*alcandola*

B.—S.t. and t.p. lines not appearing parallel throughout,

a.—*Usually* with a decided rufous cast to the wings regardless of the ground color; markings *usually* not contrasting with the ground except the orb., ren., and s.t...*erratica*

b.—Wings *sometimes* with a rufous case, but usually more ashen; *all* markings more contrasting, the t.a. and t.p. quite distinct, usually heavy..*form ornatus*

Genitalic Key to Species of Abagrotis

(I.—Uncus with sharp-pointed end,)

A.—Armature of penis an enormous spine, almost as large as the juxta, and a chitenous plate with numerous small toothlike spines. (Edge of valve with a projection about 2/3 as long as width of valve at this point ....*alcandola*

B.—Armature of penis a single heavy spine set on a chitenous hump, only. (lobation of valve at end, not on the side.)..*erratica*
and *form ornatus*

(II.—Uncus with blunt end,)

C.—Armature of penis a small spine without a chitenous base or hump, and a plate with numerous small heavy toothlike spines, the largest of these being about 2/3 the size of the solitary spine. End of valve simple and rounded)................................*bimarginalis*

ABAGROTIS ERRATICA, Sm.

1890. Sm., Trans. Am. Ent. Soc., XVII, 41, *Agrotis*.
1890. Sm., Bull. U. S. N. M., XXXVIII, 50, *Abagrotis*.
1893. Sm., Bull. U. S. N. M., XLIV, 60, *Abagrotis*.
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 19, *Agrotis (Abagrotis)*.
1903. Hamp., Cat. Lep. Phal. B. M., IV, 623, cut p. 623, *Triphaena*.
1903. Holl., Moth Book, 180, cut p. 180, *Abagrotis*.

AGROTIS ERRATICA sp. nov.

General color ashen gray to brick red, smooth and dense in appearance. Palpi dark at side. Head and thorax immaculate. Primaries evenly clothed, the lines not much darker and not prominently relieved. Basal line indistinct geminate. T.a. line geminate, the lines very narrow, faint, outwardly oblique, not very much angulated. T.p. line rather regularly outcurved, geminate, inner line narrow, broken below vein 3; outer line punctiform. S.t. line pale, very slightly less so than ground color, relieved by a dusky preceeding line, and a general dusky coloring of the terminal space; its course very slightly irregular. In the reddish forms the transverse lines are almost entirely obsolete. Claviform wanting. Ordinary spots evenly dark filled, with a narrow defining line, small in size. Orbicular slightly oval, oblique; reniform rather narrow, upright ,very slightly constricted. Secondaries glistening, smoky fuscous, somewhat paler basally. Beneath pale, powdery fuscous, with a darker outer line and discal spot. Expands 1.36-1.50 inches. 34-37 ^{mm}.

Habitat.—Sierra Nevada, Cal. (McGlashan), Calif. (Neumoegen).

This species is very distinct from any other known to me by the peculiar association of structural characters, combining the habitus of the *cupida* group with the antennae but not frontal characters of the *pitychrous* section, and peculiar and different from all by the distinct ridge or crest to the thorax. In this feature it resembles Glaea or allies, but the form is not depressed. It will probably form a new generic type characterized by smooth front, palpi with second joint clavate, third joint minute, forming a short snout with the frontal vestiture; anterior tibia unarmed, middle and posterior spinose, thorax with vestiture smooth, consisting of flattened hair and scales, with a distinct crest anteriorly. The genital structure is not unlike that of the *cupida* group, and the insect is not unlike *cupidissima* in character. The thoracic crest is perfect in but one specimen before me.

Types are in collection Rutgers College, Coll. Hy. Edwards, and Coll. B. Neumoegen.

Type Locality: Sierra Nevada, Calif.; Calif.

Number and Sexes of Types:

Types in: Neumoegen Collection, 1 ♂; national Museum, 1 ♂; Henry Edwards Collection, ; Rutgers College.

Specimens Examined: A long series of both sexes; from, Truckee, Loma Linda, Mission San Jose, Shasta Retreat (Siskiyou Co.), and San Diego, Calif. One specimen marked, compared with type, exact, William Barnes, from California; another "Typical, agrees with type in Collection Brooklyn Museum" (Jacob Doll's handwriting), from Truckee, Calif., (Topotype?).

Genitalic Slides: 1, Calif.; 2, Shasta Retreat, Calif.; 2, Truckee, Calif. Total, 5.

This is a smooth looking species varying from dull ashen gray to brick red, through straw color. The maculation is decidedly variable in density, the orbicular and reniform often filled in, concolorous with the ground; sometimes scarcely visible.

When Dr. Smith stated that the "genital structure is not unlike that of the *cupida* group," he undoubtedly had in mind the characters of the "*pityehrous* section" (Euxoa). The genitalia is essentially different in that both the *cupida* group, and *cupidissima* have a chitenous ampulla to the clasper, whereas all forms in the subgenus Abagrotis have membraneous ampullae. In this they more closely approach the *Groups Trigona* and *Placida*.

There is a slight variation in the genitalia of *erratica,* mainly in the tips of the valves, but this is a common rather than rare feature throughout the genus Lampra.

The form *ornatus,* Sm., which is treated next appears to be merely the northwestern form of a variable species. Specimens from Shasta Retreat (in Northern California) are intermediate between *ornatus* and *erratica,* as might be expected. In genitalia the two are identical.

ABAGROTIS ERRATICA form ORNATUS, Sm.

1903. Sm., Jour. N. Y. Ent. Soc., XI, 4, *Abagrotis.*

ABAGROTIS ORNATUS, sp. nov.

Ground color creamy gray varying to darker more smoky gray, the markings clearly written, ordinary spots contrasting, discolored. Head and thorax concolorous; palpi deep chestnut brown on the sides. Primaries with all the markings present. Basal line geminate, blackish, powdery, its parts widely separated. T.a. line geminate, the inner portion vague and broken, the outer distinct, black, not sharply defined; as a whole outwardly oblique, a little outcurved in the interspaces, a longer inward tooth on the submedian vein. T.p. line geminate on the costa, the outer line narrow, powdery, even over the subcostal, thence reduced to dark venular points. Inner line blackish, powdery, narrow, crenulate: as a whole little outcurved over the cell and then a very little incurved to the inner margin. S.t. line pale, slightly sinuate, preceded and emphasized by a narrow, blackish shade, the terminal space a little paler. A broken black terminal line, which may be reduced to a series of venular dots. Fringes with a slightly paler line at base and narrowly cut with the same shade. Claviform wanting. Orbicular oval, oblique, narrowly black ringed, defining a pale annulus, within which the spot is solidly and evenly filled with rusty brown. Reniform upright, rather narrow, only a little kidney-shaped, incompletely outlined by black scales which border a pale annulus: within this the center is brown-filled and a black powering around the margins emphasize the distinctness of the spot. Secondaries smoky, paler basally, fringes pale with a reddish tinge; a blackish discal lunule apparent. Beneath reddish, powdery, with an incomplete exterior line: primaries with a darker disc and a diffuse discal blotch; secondaries with a small, rather well-defined discal lunule. Expands 1.32–1.44 inches= 33–36 mm.

Habitat: Kaslo, British Columbia, J. W. Cockle; Idaho, C. V. Piper, Three female species, one of them in excellent condition, the others somewhat rubbed and broken. The Idaho specimen is darker throughout, but does not differ otherwise from the Kaslo examples.

In the absence of the male the reference to Abagrotis is somewhat uncertain. I am assuming that the ♂ will be found to have serrated and bristle tuffed antennae because the species resembles *erratica* in general appearance and type of maculation more than it does any species of Rhynchagrotis. To the latter genus the species must be referred should the ♂ antennae prove to be simple.

Type Locality: Kaslo, B. C.; Idaho.

Number and Sexes of Types: 3 ♀.

Types in: Rutgers College.

Specimens Examined: 27 specimens total, many of them Topotypes; from, Kaslo, B. C.; Brandon, Manitoba. Two Topotypes from J. W. Cockle (Coll. Barnes), Kaslo, B. C., one of these last compared with type in the Smith Collection, by Dr. William Barnes.

Genitalic Slides: 1, Kaslo, B. C.

It is propesed to treat *ornatus* as a northern form of *erratica*. *Ornatus* only differs from typical erratica in being uniformly ashen with distinct maculation. Specimens of *erratica* from type locality often present a similar appearance; and specimens from an intermediate locality (as already stated) are usually intermediate.

ABAGROTIS ALCANDOLA, Sm.

1908. Sm., Can. Ent., XL, 288, *Rhynchagrotis*.
1917. B. & McD., Check List, p. 48, # 1564, *Abagrotis*.

TRISTIS, B. & McD.

1912. B. & McD., Cont. Nat. Hist. Lepid. N. A., I, No. V, 8; pl. I, fig. 17, *Abagrotis*.
1917. B. & McD., Check List, p. 48, # 1564,=*alcandola,* Sm., *(Abagrotis)*.

RHYNCHAGROTIS ALCANDOLA, Sm.

Ground colour pale luteous-gray. Sides of palpi dark brown. Primaries very uniform in general tint. Basal line barely indicated on costa. T.a. line faintly indicated by scattered black scales, its course outwardly oblique. T.p. line geminate, consisting rather of venular points connected by black scales, very evenly outcurved over the cell and very slightly incurved below it. The s.t. space is black powdered, deepening to a distinct shade before the pale, slightly irregular s.t. line, which is the most obvious feature of the wing. Small terminal black points in the interspaces and a pale yellow line at base of fringes. Orbicular irregular, oblique, blackish filled, with a narrow yellow defining line. Reniform large, blackish filled, with a narrow yellow defining line; nearly upright, a little drawn in at center. Secondaries smoky, paler at base. Beneath powdery, with an extra medial dusky line and discal spot.

Expands—1.40 inches=35 ^{mm}.

Habitat—Yavapai Co., Ariz., Oct. 4, Mr. Hudson. One female, in good condition only. Prof. F. H. Snow has other examples and I sent him the MMS. name some time since expecting to get additional material for the description. It is to validate the name sent out that I base the species on a single defective example, knowing that there are other and better ones in collections.

The species is perhaps nearest to alternata, but obviously distinct in the course of the s.t. line, the dark s.t. space and in the form of the ordinary spots.

Type Locality: Yavapai Co., Arizona.

Number and Sex of Types: 1 ♀.

Type in: Smith Collection.

Specimens Examined: 1, compared with type *alcandola,* identified by Dr. Barnes; 1 ♂ "Type" (Holotype) *tristis;* 2 ♂ "Cotypes" (Paratypes) tristis; 4 other ♂s; total 8 specimens from Santa Catalina Mountains, Ariz.; Ariz.; S. Ariz.

Genitalic Slides: 1, Santa Catalina Mountains, Ariz.

ABAGROTIS TRISTIS, sp. nov. (Plate 1, Fig. 17)

♂. Thorax and primaries deep reddish; maculation with the exception of the reniform and s.t. line indistinct; all the lines geminate; basal line black, only slightly marked by the paler filling; t. a. line angled outwardly below costa and almost touching orbicular, then evenly oblique to submedian fold where it forms a slight inward angle; orbicular large, oval, oblique, with pale flesh colored annulus and partially black border, filled with ground color; reniform broad, upright, scarcely constricted, largely filled with blackish and with pale annulus and slight black border; t.p. line very indistinct, outcurved below costa, then slightly waved and parallel to outer margin, both lines defined by black points on the veins in the central area; s.t. line pale flesh color, rather prominent, in general parallel to outer margin; faint terminal row of black points and pale basal line to dusky fringes. Secondaries smoky, paler at base with pinkish fringes and faint discal spot. Beneath white, sprinkled with smoky brown and suffused along costa and outer margin with reddish; a postmedian line and discal dot on both wings. Expands 38 mm.

Habitat--Santa Catalina Mts., Arizona (Chrisman) (Sept.) 3 ♂♂. Type, Coll. Barnes.

Agrees generally with *erratica* Sm. from which it differs in the much brighter coloration and larger reniform and orbicular.

TYPE LOCALITY: Santa Catalina Mountains, Ariz.

NUMBER AND SEX OF TYPES: Holotype ♂; 2 "Cotype" ♂'s (Paratypes.)

TYPES IN: Barnes Collection.

The male antennae are serrate to the tips, the length of the serrations being approximately subequal to the width of the shaft.

It appears to average slightly larger than *erratica,* its nearest ally. The reniform and orbicular are also, in general, larger. The s.t. and t.p. appear sub-parallel except at the extreme costa.

ABAGROTIS BIMARGINALIS, Grt.

1883. Grt. Ann. & Mag., N. H., XI, Fifth Series, (London), 53, *Agrotis.*
1883. Grt., Trans. Kans. Ac. Sci., VIII (1881-2), 54 (Reprint) *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 26 *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 54, *Rhynchagrotis.*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 634, pl. LXXVII, fig. 6, *Triphaena.*
1908. Sm., Can. Ent., XL, 223, *Rhynchagrotis.*

AGROTIS BIMARGINALIS, n. s.

Allied to *variata* and *observabilis.* Head and thorax rich orange-brown; a broad pale leather-brown or fawn-coloured costal stripe to terminal posterior line; terminal space frosted with white. Rest of the wing deep brown, shaded with black. Terminal posterior line even; stigmata obscured by the blackish shading; subterminal space black on costa. Hind wings pale fuscous; abdomen brownish terminally. Beneath with dots and a common even exterior shade band. No. 924. Expanse 36 mm.

Type Locality: Gallinas Cañon, Las Vegas, New Mexico.

Number and Sex of Types: 1 ♀, Neumoegen Collection; 1 ♀, Snow Collection.

Types in: Neumoegen and Snow Collections.

Specimens Examined: 1 ♂, Jemez Springs, N. Mex; 1 ♂, compared with type, Redington, Ariz. (in the Barnes Collection); 1 ♀, compared with type in Brooklyn Museum, by Messrs. Doll and Engelhardt (in the Neumoegen Collection).

Genitalic Slides: 1, ♂, Jemez Springs, N. M.

This is apparently a rare species, as Dr. Smith had no specimens, and the Barnes Collection only possesses two males.

It is easily separated from all species of the genus Lampra by its buff costa, except for an occasional specimen of *vittifrons.* Only the females can be confused as the male of *bimarginalis* has serrate antennae, which places it in the subgenus Abagrotis. The serrations are between those of *erratica* and *alcandola* in size. Toward the tip, the antennae appear lamellate; the serrations and lamellations reaching about three-fourths of the length of the shaft. The occasional female that may be confused with *vittifrons* can easily be distinguished by its larger size; about one and one-half inches, as against one and one-quarter inches for the largest *vittifrons.* The more obscure maculation, the collar not concolorous with the costal margin of the primaries and the fuscous secondaries are additional characters, by which *bimarginalis* differs from the more definite maculation, collar and costal margin concolorous, and pearly white secondaries (with only the veins and margins fuscous) of *vittifrons.*

Genitalically the two are quite distinct; but similar in general appearance.

SUBGENUS LAMPRA, Hbn.

This subgenus is characterized by its simple, ciliate antennae in the male; and by the thoracic crest either divided laterally or absent, never with a distinct keel-like ridge on the collar and prothorax.

Many of the species seem to be in an unstable evolutionary state, the genitalia varying remarkably within the species, in some groups. This will be taken up more in detail in the various groups.

The groups mentioned herein are purely arbitrary and merely created for convenience in identification. Hence they are as small as it seems possible, at this time, to make them.

At first it was intended to key the whole subgenus as a single group genitalically but more mature consideration points to the conclusion that it is better to first separate into groups on structural and superficial characters, and then to key to species.

Key to the Groups of the Subgenus Lampra

I.—Thorax with a spreading divided crest,

- A.—Crest large, conspicuous,
  - a.—Primaries with a longitudinally striate appearance due to the basal dash extending to the t.p. line; and the black filling of the cell extending basally of the orbicular and outwardly of the reniform. Ordinary spots when visible show as white patches; reniform usually large; orbicular often dwindling, (ampulla of clasper membraneous) .... *Mirabilis*
  - b.—Not so,—the black markings never presenting a longitudinally striate appearance, orbicular and reniform never showing as white patches, (ampulla of clasper always strong and chitenous),
    - a^1.—Antennae of male with long cilia arranged in blocks on the segments; when viewed under a strong lens causing an almost lamellate appearance due to their absence between the joints, (penis armed with both spine and numerous small spines on a plate) .... *Insularis*
    - b^1.—Antennae of male simply ciliated, the cilia not arranged in blocks on the segements, (penis armed with single spine only) *Exsertistigma*
- B.—Crest small, easily lost; often not visible on rubbed specimens, (ampulla of clasper membraneous) .... *Discoidalis*

II.—Thorax without spreading divided crest,

- A.—Cell between stigmata filled in with black, contrasting against the ground color of the primaries .... *Discoidalis*
- B.—Not so—if cell is black filled there is no contrast with the ground color of the primaries,

a.—Costal region of the primaries shows as a clear creamy white streak, concolorous with or but slightly lighter than the collar, (ampulla of clasper membraneos).......................................*vitifrons*

b.—Not so,—costal region never a white streak,

a[1].—Head and collar concolously dark, brown or brownish, contrasting with the ground color of the primaries and thorax, (ampulla of clasper chitenous) ....*Brunneicollis*

b[1].—Not so,—head and collar if concolorously dark not contrasting with the ground color of the primaries and thorax,

a[2].—Wing-form short, stubby, trigonate (all except from the far Northwest with male antennal segments ciliated with blocks of long cilia, presenting under a lens a sublamellate appearance) (ampulla of clasper membraneous) ....*Trigona*

b[2].—Wing-form not trigonate,

a[3].—Primaries with a blueish underlay of smaller scales; transverse maculation usually visible and scaled with same color, (containing two species,—*variata,* the largest in the genus, and *scopeops,* one of the smaller forms. Only *scopeops* liable to confusion, with a form of "*placida.*" It only occurs in B. C., Wash., Ore., and N. Calif., always with the orbicular round; not large, and outlined by a clean line) (ampulla of clasper membraneous ....*Variata*

b[3].—Not so,—seldom with a blueish tint to the primaries; if blue scaling be present it is restricted to the terminal area of the primaries (except in the *placida form* mentioned above,

a[4].—Size large, wings broad, primaries square-cut,

a[5].—S.t. line two toothed, lower tooth subdivided into W-mark; (ordinary spots easily visible, clearly outlined; orbicular large, oblique, often somewhat flattened) (ampulla of clasper membraneous)................................*Alernata*

b[5].—S.t. line without the W-mark; (orbicular round or sub-round; only in aberrant specimens oblique, sometimes absent),

a^6.—Orbicular always present, *large*, sometimes not round, (ampulla of clasper chitenous) .... *Anchocelioides*

b^6.—Orbicular present or absent, if present *small* and *round*, (ampulla of clasper membraneous) .... *Nefascia*

b^4.—Size moderate (size of *cupida*),

a^5.—Eastern material, (ampulla of clasper chitenous) .... *Anchocelioides*

b^5.—Western material, (must be run down genitalically, or by careful comparisons, as no characters hold to separate from "*placida*" forms except general appearance. All specimens with a median shade are "*placida*."*

c^4.—Small size.

a^5.—Eastern material.

a^6.—Primaries conspicuously narrow for their length, with a shiny, glossy, satiny appearance due to being very smoothly scaled; transverse maculation often obscure; never with a median shade; terminal area usually concolorous with median area; rarely slightly lighter, (runty specimens of *cupida*) (ampulla of clasper chitenous) .... *Anchocelioides*

b^6.—Primaries not conspicuously narrow for their length, sometimes shiny, but never with a sleek, glossy, satiny appearance; transverse maculation usually distinct; at least a trace of the median shade usually present; terminal area often blueish, not concolorous with median area, (ampulla of clasper membraneous .... *Placida*

b^5.—Western material, (must be run down genitalically to separate from closely approaching "*placida*" forms or very carefully compared, except:—

a^6.—Median shade present, (most) .... *Placida*

b^6.—Median shade absent,

a^7.—Ground color black, suffused, shining; orbicular clearly outlined with whitish, small and round, (usually from Utah or California: species—*duanca* only) .... *Nefascia*

b^7.—Not so,—*

*This leaves merely the *Placida* and *Nefascia* Groups with

the following species to be separated genitalically:

L. *"placida,"* from (about 20% without median shade) — runty specimens of *L. barnesi*; *L. nefascia*; *L. forbesi*

See discussion of the Nefascia Group which will reduce this still further.

Genitalic Key to Separate aberrant *"PLACIDA"* from *FORBESI, BARNESI* and *NEFASCIA*

I.—Penis with peculiar, conspicuous ridges besides the other armament .... *Forbesi*

II.—Not so,—penis without conspicuous ridges,

A.—Comb of penis modified into a huge plate with teeth at the end and with a decided tendency to be *projecting* from the aedoegus.......... *barnesi*

B.—Not so,—(comb present or absent, seldom projecting, never completely fitting characters given under A,

a.—Sacculus large and lobate; arm of valve slender, so that when spread out the arm appears as a mere crook beneath the sacculus, (comb of penis present).......... *nefascia*

b.—Not fitting this description, comb of penis either present or absent; very variable.......... *"placida"*

GROUP VITTIFRONS

This group contains a single species, *vittifrons, Grt.*

The group is readily distinguished from all others in that the costal margin of the primaries is creamy white, and in all specimens examined almost concolorous with the collar. In addition the thorax is without crest; and the antennae of the male is finely ciliated; with four longer cilia from each joint, all in the same lateral plane.

LAMPRA VITTIFRONS, Grt.

1864. Grt., Proc. Ent. Soc. Phil., III, 527, pl. 5, f. 8, *Noctua.*
1868. Grt., Trans. Am. Ent. Soc,, II, 309, *Agrotis.*
1890. Sm., Bull U. S. N. M., XXXVIII, 26, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 54, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 633, pl. LXXVII, f. 4, *Triphaena.*
1908. Sm., Can. Ent, XL, 224, *Rhynchagrotis.*

NOCTUA VITTIFRONS, nov. sp. (Plate 5, fig. 6. ♀)

Anterior wings blackish, ordinary lines interrupted, pale; a broad costal dull cream colored band; ordinary spots sub-obsolete. Transverse anterior line undulate, indistinct; orbicular spot wanting, reniform irregular, dark cream color; transverse posterior line very slightly bent at the disc, followed by a series of similarly colored spots on the veins, which latter are darker shaded in the terminal space; sub-terminal line undulate, continued, broadly marked at costa; fringes somewhat paler than the wing. Under surface whitish, with a blackish sub-terminal shade, broadest at costa. Posterior wings whitish, immaculate, with pale brownish scales along the veins; fringes whitish. Under surface whitish, sprinkled with pale brownish along the costa and at costal angle. Collar concolorous with the costal band of anterior wings, but with a deeper tint at the center; head blackish, paler on the front; palpi blackish, terminal joint pale; thorax and tegulae blackish; abdomen cinerous above, paler underneath; legs cinerous, tarsi paler. Exp. ♀ 1.35 inch.

Habitat.—Colorado Ter., Mr. J. Ridings. (Coll. Ent. Soc. Phil.)

With *Noctua plecta* Linn. and *N. achrogaster* Guenee belonging to Boisduval's genus Chersotis (Ochropleura Hubn.). It is a more robust and darker colored species than these, and with them cannot be generically separated from the other species of the genus Noctua.

Type Locality: Colorado.

Number and Sex of Types: 1 ♀

Types in: Am. Ent. Soc., Phila.

Specimens Examined: Total, 20; from, Fort Wingate, N. Mex.; Glenwood Springs, Colo.; Eureka, Deer Creek, Stockton, Utah; So. Utah; Reno, Nev.; Truckee, Calif.; and Colo., (Bruce) ex. Coll. Jacob Doll. One specimen, compared with type, Eureka, Utah.

Genetalic Mounts: 1, Colo., (Bruce).

GROUP TRIGONA

This group contains two species: *trigona*, Sm., and *sambo*, Sm.

It is readily distinguished from all other groups by the short, stubby wingform, (trigonate wingform of Smith). In addition the thorax is without a distinct crest; altho in some specimens the thoracic vestiture is so arranged that a *trace* of a keel-like crest is barely visible. The antennae of the males have a dense scaling to the joints; and the cilia are as long or longer than the width of the shaft, projecting directly outward in block-like pattern. This combination, coupled with the absence of the cilia from the ends of the antennal segments, causes a subserrate appearance to the antennae. This is quite a conspicuous feature in *trigona*. In *sambo* the antennae of the males is of this pattern for only about one-half of the length of the shaft, the terminal half being more of the type of *placida*. The wings of *sambo* are slightly less trigonate than those of *trigona*.

The Trigona Group appears to be a connecting link between the Placida Group and the Subgenus Abagrotis.

Superficial Key to the Trigona Group

I.—Wingform short, stubby, broadly trigonate; antennae of male with cilia arranged in block-like pattern on the segments, causing a subserrate appearance due to their absence between the segments...*trigona*

II.—Wingform, while trigonate, longer in proportion to the size of the insect, which is, in general, smaller; antennae of male with cilia arranged in block-like pattern on the segments, on the basal half of the shaft only (the terminal half being more nearly like that of *placida*, not appearing subserrate; British Columbia only) .... *sambo*

LAMPRA TRIGONA, Sm.

1890. Sm., Bull. U. S. N. M., XXXVIII, 24, *Rhynchagrotis cupidissima*, Sm., nec. Grt.

1893. Sm., Bull. U. S. N. M., XLIV, 53, *Rhynchagrotis*.

1895. Grt., Abh. Nat. Ver., Bremen, XIV, 58, *Agrotis (Lampra)*.

1903. Hamp., Cat. Lep. Phal. B. M., IV, 640, pl. LXXVII, f. 3, *Triphaena*.

1908. Sm., Can. Ent., XL, 287, *Rhynchagrotis*.

R. TRIGONA Smith n. sp.
cupidissima ‡ Smith.

1890. Smith. Bull. U. S. Nat. Mus., No. 38, 24, *Rhynchagrotis*.

Habitat.—California; Oregon; Colorado; Arizona; Kansas; British Columbia; Glenwood Springs, Colorado, in August.

Mr. Grote had named *cupidissima* in Mr. Neumoegen's collection, a series of specimens which I assumed were correctly determined. Interpreting Mr. Grote's descriptions by these specimens, I made *orbis* and *laetula* synonyms of *cupidissima* in the monograph. The true *cupidissima* is very different from this species, and neither *orbis* nor *laetula* agree at all with it. A new name for what I have erroneously characterized as Mr. Grote's species is therefore necessary, and I propose *trigona*, as above. The types of this species are the specimens named *cupidissima* by me in the collections U. S. National Museum.

Bull. U. S. N. M., XLIV, 19, 1893, reads: "‡Name cited in error."

Bull. U. S. N. M., XXXVIII, 24, 1890, referred to by Dr. Smith in his original description of *trigona*, reads:

RHYNCHAGROTIS CUPIDISSIMA, Grt.

1875. Grt., Can. Ent., VII, 101, *Agrotis*.

1878. Grt., Can. Ent., X, 234, *Agrotis*.

1878. Grt., Bull. Surv., IV, 173, *Agrotis*.

1883. Grt., Proc. Am. Phil. Soc., XXI, 155, *Agrotis*.

orbis Grt.

1876. Grt., Bull. Buff. Soc. N. Sci., III, 83, *Agrotis*.

1878. Grt., Bull. Surv., 174, *Agrotis*.

1883. Proc. Am. Phil. Soc., XXI, 155, an syn. pr.?

laetula Grt.

1876. Grt., Bull. Buff. Soc. N. Sci., III, 83, *Agrotis*.

1878. Grt., Can. Ent., X, 234, pr. syn.

1878. Grt., Bull. Surv. IV, 173, an sp. dist.

"The California specimens are light red colored, with powdery geminate lines, and variable in appearance; one is pale fawn, unicolorous, without marks on primaries save indications of the stigmata and the dotted t.p. line. Again, three specimens have the orbicular somewhat V-shaped, open above. The t.p. line is more regular than in *cupida;* it is accompanied by black dots. The subterminal line is nearer to the margin than in either *alternata* or *cupida*, but it is more like *alternata* than it is *cupida* in its being irregular, accompanied with powdery black scales; it is preceded on costa by a blackish shade, as in *cupida*. The present species I formerly considered as *alternata* from the markings, and on Mr. Morrison's authority as *cupida* from the color, but the reniform I now see is more kidney-shaped than in either the eastern *alternata* or *cupida*. I sent a specimen to Mr. Morrison to show the variability of what I supposed was his *exsertistigma*, and he informed me that the specimen was *cupida*. Afterwards he returned me my specimen of *exsertistigma*, . . . which I then saw was an entirely different species. I have subsequently adopted the view that the California specimens were *cupida*, and that I was in error in considering them to be *alternata*. I now reject both determinations, and consider that the California species is allied to both *alternata* and *cupida*, and is a new species from the data given above. The habitus of *cupidissima* and size (39^{mm}) is rather that of *alternata*. The hind wings are a little paler at base in *cupidissima*, and the lunule more obvious. *A. cupida* does not as yet appear to occur in California."

The above is Mr. Grote's original description; afterward, in Can. Ent., X, 235, he refers to the species as of a "pale reddish clay color," and in the Bull. Surv., IV, 173, says: "Nearest to *cupida;* similarly sized, but paler, with the orbicular incomplete superiorly. Varies by the primaries becoming clay colored without markings. Collar unlined."

Mr. Grote has confounded two distinct species in his characterizations—one with open orbicular, and one with the orbicular closed. A long series of specimens in Mr. Neumoegen's collection are all of one species and are regarded as typical, the more as Mr. Grote's references of *orbis* and *lœtula* to this species is most consistent with this type.

The species is common in the Western States, and I have seen long suites, in none of which the orbicular showed any tendency to become incomplete. They vary in color from very pale luteous to a very distinct red-brown, the terminal space usually a little paler, but the color very even as a whole. Sides of palpi black. Transverse lines and ordinary spots much as in *alternata*, but generally indistinct and difficult to make out. Ordinary spots usually slightly and often considerably darker and narrowly annulate with a paler shade. Secondaries and under side as in *alternata*. In size it ranges *below* the expanse given by Mr. Grote (39^{mm}), my largest specimen being 35^{mm}, ranging down to 30^{mm} (1.20-1.40 inches). The wing-form is generally more trigonate than in the other species, the primaries short and broad. The genital structure is like *placida*.

Orbis was described by Mr. Grote as follows:

"Entirely concolorous drab or pale olive fuscous, shining; s.t. space barely differentiated by its darker tint. All the lines faint, geminate, as in allied species. Distinguished by its reduced, round, complete orbicular, and small, upright reniform spots, annulated with pale; the orbicular distinctly margined. Head and thorax concolorous. Hind wings concolorius, fuscous with interlined fringes; beneath with discontinued common line."

In Bull. Surv., IV, 174, Mr. Grote says: "Closely allied to *alternata.* Stigmata complete; orbicular very small, pale-ringed, spherical. Unicolorous olivaceous gray, shining; terminal space hardly paler. Possibly a variety of *alternata,* but the spots are concolorous."

In the Proc. Am. Phil. Soc., XXI, 155, the suggestion that this may be a form of *cupidissima* is made, and I believe this is correct. At all events it is easy in any series of *cupidissima* to pick out *orbis* or what fully answers to the description.

Laetula is said to be "Allied to *cupidissima.* This species is smaller and has a line on the collar, and the thorax and fore wings of a burnt brown, strewn with ochre scales, which fill the stigmata in one specimen, and in the other leave the spots concolorous, while encircling them and filling the geminate lines. Except in color, this form differs very little from *cupidissima,* while seeming narrower and shorter winged. All the stigmata shown. Hind wings and under surface as in *cupidissima,* which is a light red species."

In Can. Ent., X, 234, the reference to *cupidissima* is more positively made, but in Bull. Surv. IV, 173, the following are indicated as distinctive:
"Darker than the preceding *(cupidissima),* purple brown, with powdery ochrey markings; claviform indicated, collar unlined, a little smaller than *cupidissima."*

The only specimen of *laetula* which I have seen labeled by Mr. Grote did not agree with this description at all and was the same as the *observabilis* of Mr. Graef's collection, belonging to the *exsertistigma* group rather than here. Mr. Grote speaks of all these forms from California only. I have them from California, Colorado, Arizona, Kansas, and British Columbia.

Dr. Smith's first complete description of *trigona* appeared in Can. Ent. XL, 287, 1908; and appears to be a good and accurate one, except that the author has before him a number of very dark forms, mostly from California. Also, the thoracic vestiture and antennal characters, mentioned in this paper under the heading Group Trigona, are omitted and appear to have been overlooked by Dr. Smith.

The following is quoted from Can. Ent., XL, 287, 1908:

RHYNCHAGROTIS TRIGONA, Sm.

This species differs at once from all the preceding in the shorter, broader, more triangular wings. The primaries are usually of some shade of pale luteous, tending to receive a reddish admixture in one direction and a smoky admixture in another. As a rule, while all the maculation is present in the specimens, it is scarcely relieved and does not disturb the apparent uniformity of the wing. Exceptionally the ordinary spots will become black, contrasting, and the lines, or some of them, may be blackish. I have a long series of examples from Colorado Springs in June and July, a very long series taken by Mr. Buckholz in Yavapai County, Arizona, in July, and a small series from Fort Wingate, New Mexico, in July. Altogether over 100 examples, and enough to get a fairly good idea of what the species looks like.

Type Locality:

Number and Sex of Types:

Types in: National Museum; Smith Collection.

Specimens Examined: Total, 127; from, Shasta Retreat, Siskiyou Co., Calif.; Deer Park Springs, Lake Tahoe, Calif.; Camp Baldy, San Bernardino Mts., Calif.; Nellie, Yosemite and Plumas Co., Calif.; Vineyard, Stockton and Provo, Utah: Salida, Colo.; Glenwood Springs, Colo.; Las Vegas, N. Mex.; Jemez Springs, N. Mex.; Prescott, Ariz.; S. Ariz. (Poling). One specimen, compared with type (marked "exact, W. B."); and one specimen marked "*trigona* a/c Sm. & N. M. Coll." (in Dr. Barnes' handwriting); are in the Barnes Collection, the last from Salida, Calif.

Genitalic Slides: 1, Stockton, Utah; 1, Shasta Retreat, Calif.; 1, Arizona; 1, Glenwood Springs, Colo.

This species is genetalically distinct from all others examined by the author. in having a heavily chitenized, strongly raised, V-shaped mound on the juxta.

LAMPRA SAMBO, Sm.

1908. Sm., Can. Ent., XL, 287, *Rhynchagrotis.*

RHYNCHAGROTIS SAMBO, n. sp.

Has the trigonate primaries of *trigona,* but is smaller and the wings are a little longer, not quite so stubby. Maculation also as in *trigona,* but much better defined, while the s.t. line is pale, preceded by a distinct blackish or dusky shading. While there are some almost uniform examples, the tendency is all in the opposite direction, the basal area becoming darker between the basal and t.a. line until a conspicuous black band appears; the s.t. space in turn may also become darker until it is completely black filled; one example, with basal and s.t. bands and ordinary spots lost, presenting an appearance that proved puzzling until the series now in hand was examined. Secondaries blackish, fringes rufous.

Expands.—1.16-1.28 inches (29-30^{mm}).

Habitat.—Kaslo, British Columbia, July and August, Mr. Cockle; Peachland, B. C., in July, Mr. Wallis, through Dr. Fletcher; Ainsworth, B. C., in July, Mr. Findlay, also through Dr. Fletcher.

A series of 12♂'s and 12♀'s, most of them in good or fair condition, and while extremely variable, yet in altogether a different direction from *trigona,* which is approached only in one or two very uniform examples.

Type Locality: Kaslo, B. C. (Mr. Cockle); Peachland, B. C. (Mr. Wallis); Ainsworth, B. C. (Mr. Findlay).

Number of Sexes of Types: 12♂, 12♀.

TYPES IN: ("Male Type"), ("Female Type"), 1 ♂, 1 ♀, Paratypes ("Cotypes"), no locality label, Collection Rutgers College; 1 ♂, 1 ♀, Paratypes ("Cotypes"), from Peachland, B. C., with small round date label only, Barnes Collection.

SPECIMENS EXAMINEDS 10 ♀'s and ♂ and ♀ Paratypes; from, Peachland, B. C.; Duncans, Vanc.; Quamichan Lake, Vanc.; also 1 ♀ Duncans, Vanc.; and 1 ♀ Peachland, B. C., through the kindness of Mr. Wallis.

This species has been confused to a large extent. There is really but little reason for it except that the males seem comparatively rare in collections. Superficially it seems distinct from its nearest ally *trigona,* as demonstrated by the male antennae.

As Dr. Smith states, it is a slightly smaller species, with wings less trigonate and longer in proportion. The variation in wing maculation mentioned in the original description is impossible to check at this time; but there seems no reason to doubt it, as specimens before the author show a tendency in that direction.

The species seems to inhabit British Columbia only, and appears to be the connecting link between *"placida"* and *trigona.* The author has seen no authentic *trigona* from British Columbia.

GROUP MIRABILIS

This group contains only a single species—*mirabilis.* It is easily separated from the rest of the genus by the striate appearance of the primaries due to the basal dash extending as far as the t.p. line, while the black filling of the cell is continued basally of the orbicular and outwardly of the reniform. The ordinary spots are white, varying greatly in size. Normal specimens have the reniform large and very conspicuous. Thorax with a well-developed, distinct, divided crest and usually with a disconcolorous, rufous patch on the dorsum. Antennae simple, ciliate, with the setae near the base subequal to the cilia, becoming about twice as long as the cilia near the tip. The ampulla of the clasper is membraneous. This is the only known species in the genus with a well-developed, divided crest; and not possessing a clasper with a chitenized ampulla. *Discoidalis* comes nearest with a considerable vestige of a divided crest in fresh specimens, easily rubbed off and usually not plainly visible.

LAMPRA MIRABILIS, Grt.

1879. Grt., No. Am. Ent., I, 39, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 28, *Rhychagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 54, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 635, pl. LXXVII, f. 8, *Triphaena.*
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*

AGROTIS MIRABILIS, n. s.

♂. Fore tibiae unarmed; male antennae simple. Blackish fuscous; terminal space paler, powdered with grayish. Lines obliterate. Median lines approximate. Subterminal defined by difference of shade. Ciscal spots contrasting, yellowish or ochery white in a black shade; orbicular reduced, reniform moderate, subquadrate. A whitish dot in front of insertions of fore wings. Head collar and tegulae concolorous; dorsum of the thorax pale reddish, contrasting; tegulae with indistinct inner black edging. Hind wings dark fuscous, with pale interlined fringes. Beneath dark fuscous powdered with grayish; on primaries the inception of common line marked in black, and costal dots. Expanse 36 mm. Allied to *discoidalis,* but very different in color.

Type Locality: Idaho Springs, Colorado (Prof. F. H. Snow).

Number and Sex of Types: ♂

Types in: British Museum.

Specimens Examineds Total, 23; from, Glenwood Springs, Colo.; Colo. (Bruce); Provo, Utah; Fort Wingate, N. Mex.; Yavapai Co., Prescott, and White Mountains, Ariz.; Esmeraldo Co., Nev. One male, compared with type, by Sir George Hampson, Glenwood Springs, Colo.

Genetalic Slides: 1, Glenwood Springs, Colo.

GROUP DISCOIDALIS

This group contains a single species, *discoidalis.* It is easily separated on its peculiar appearance, different from anything else in the genus. Upon close examination it shows a strong relationship to *mirabilis.* The cell is normally filled in with black and the black usually continued basally to the t.a. line; or with at least a trace of black scaling, giving this space a dark appearance. There is a trace of the crest on the thorax, only visible in fresh specimens and easily lost. *Discoidalis* possesses the same disconcolorous rufous patch on the dorsum of the thorax as *mirabilis.* The antennae also are much the same; the setae small at the base, subequal with the cilia, longer toward the tip. The ampulla of the clasper is membraneous.

Discoidalis and *mirabilis* are the only two species that possess the spreading, divided crest on the thorax, but have the ampulla of the clasper membraneous.

LAMPRA DISCOIDALIS, Grt.

1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 82, pl. 4, f. 9, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 36, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 56, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 636, pl. LXXVII, f. 9, *Triphaena.*
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*

AGROTIS DISCOIDALIS, n. s.

♀.—Fore tibiae unarmed; appearing allied to *attenta*. Fuscous or wood brown. The geminate lines as usual in this group. Cell black. Stigmata concolorous; orbicular elongate ovate; reniform upright. Subterminal space the darkest. The general color is fuscous with a grey shade except on subterminal space. The distinctive character of this species is the black shading around the orbicular on the cell. There is a trace of the claviform. Hind wings pale fuscous with interlined fringes and the veins marked. Beneath paler with faint line and discal mark.

Expanse, 34^{mm}. No. 5609, Nevada, Mr. Hy. Edwards.

Type Locality: Nevada ? (Sierra Nevada according to Sir George Hampson).

Number and Sexes of Types:

Types in: British Museum, 1 ♀.

Specimens Examined: Total, 31; from, California; Northern California; Central California; Truckee, and Plumas Co., Calif.; Pyramid Lake, and Esmeraldo Co., Nev.; Vineyard, Eureka, Provo and Stockton, Utah. One specimen, compared with type by Sir George Hampson, California.

Genetalic Slides: 1, Pyramid Lake, Nev.; 1, Stockton, Utah.

This species has been sufficiently discussed under Group Discoidalis and Group Mirabilis to need no further discussion, in view of the fact that Mr. Grote's description is very clear and concise.

GROUP PLACIDA

The Placida Group contains one named species and one aberration, viz: *placida* and ab. *minimalis*. This is a heterogeneous group, in a most unstable evolutionary state. Scarcely any two specimens of "*placida*" look alike, and at least minor differences occur in the genetalia of almost every example which the author examined. No single character or group of characters seem stable. The writer prefers to consider "placida" as a name applied to a group, as well as to a single definite species. Grote's type coming from New York, the name might fittingly be applied to Eastern specimens. For the sake of convenience the group name "placida" will have to stand for Western material as well. Eastern *placida* may vary in the same way as Western. It is scarce, coming from the Adirondack Plateau, and only one specimen was available for study.

In the West "*placida*" reaches its magnitude, producing forms resembling almost every species that lacks a thoracic crest. From the Placida Group appear to have arisen, Eastern *placida, sambo,* and *scopeops* as illustrated in the phylogenetic relationship diagram. These species seem separate and worthy of names, as far as can be judged by our present knowledge. Utah and Colorado material seems to show the greatest instability, probably due to the various environments to be found within limited areas. It is worthy of note that "*placida*" from Utah often resembles *forbesi* or *nefascia;* New Mexico material resembling *nefascia* or *barnesi;* Colorado material, *nefascia;* while Vancouver shows forms similar to *scopeops*.

It is distinctly probable that certain races, forms, or species in the *placida series* deserve names, and will in time be named. Also, there is the distinct probability of hybridization occurring between "*placida*" and allied forms, or between forms within the *placida series*. At the present time it seems better to await more material of true Eastern *placida*, or full life history notes and larval characters before putting a series of names into the literature which will only confuse and in the end may have to be relegated to the synonomy.

Key to the Placida Group

Lines usually double, median shade + or –, color variable, ..."*placida*"

Lines single, median shade +, color reddish, ab. *minimalis*.

LAMPRA PLACIDA, Grt.

1876. Grt., Ann., Lyc. Nat. Hist., N. Y., XI, 305, *Agrotis*.
1878. Grt., Can. Ent., X, 235, *Agrotis*.
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis*.
1889. Butl., Trans. Ent. Soc. Lond., p. 383, = *cupida*.
1890. Sm., Bull. U. S. N. M., XXXVIII, 21, *Rhynchagrotis*.
1893. Sm., Bull. U. S. N. M., XLIV, 52, *Rhynchagrotis*.
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra)*.
1903. Hamp., Cat. Lep. Phal., B. M., IV, 635, pl. LXXVII, f. 10, *Triphaena*.
1903. Holl., Moth Book, p. 178, pl. XXI, f. 23; pl. XXI, f. 21, "red form *placida*" *(minimalis text)*, *Rhychagrotis*.
1908. Sm., Can. Ent., XL, 227, *Rhynchagrotis*.

AGROTIS PLACIDA, N. S.

Fore tibiae unarmed: antennae simple. Fuscous gray. Fore wings smooth, dark fuscous. Basal and subterminal spaces blaskish and darkest: median space a little lighter, slightly brownish; terminal space gray, contrasting. Lines even, perpendicular, pale. Transverse anterior line with a slight subcostal notch, slightly oblique; median space wide; stigma difficult to make out, pale ringed, concolorous; median shade noticeable, obscuring the reniform. Transverse posterior line with a slight outward costal extension beyond the point of origination, thence somewhat squarely exserted opposite the cell, and running nearly straight downwards without submedian sinus. Subterminal line indicated by the great difference in color between the two terminal spaces; fringes dark. Hind wings concolorous, rather dark fuscous, with paler interlined fringes. Beneath fuscous, with a slight purply shade, irrorate, with an external common band incomplete; a slight discal mark on hind wings. Terminal abdominal hairs somewhat ocherous. Expanse 35 mm. Lewis Co., N. Y., July 26.

Differs from other species of the *cupida* group in the shape of t.p. line at costa.

Type Locality: Lewis Co., N. Y.

Number and Sexes of Types: ♀.

Types in: *British Museum*, 1 ♀.

Specimens Examined: exclusive of genitalic slides: 2 ♀, Duncans, Vanc.; 1♀, Arrowhead Lake and 1 ♀, Kaslo, B. C.; 1♀, Brandon, Manitoba; 3 ♀, Cartwright, Man.; 2 ♂, 2 ♀, Calgary, Alberta; 4 ♀, Hymers,

Ont.; 2 ♀, Colo.; 1 ♀, Colo. (Bruce); 1 ♀, Manitou, Colo.; 3 ♂, 32 ♀, Glenwood Springs, Colo.; 7 ♂, 8 ♀, Provo, 4 ♂, 7 ♀, Stockton; 3 ♂, 6 ♀, Deer Creek, and 1 ♂, 8 ♀, Vineyard, Utah; 1 ♀, S. Dak.; 3 ♂, 12 ♀, Truckee, 3 ♂, 2 ♀, Shasta Retreat, 1 ♀, Yosemite, and 1 ♀, Durango, Calif; 1 ♀, Hot Springs (Green River), Wash; 2 ♀, Jemez Springs, N. M. Total, 125. Also 1 ♀, compared with the type in the British Museum, by Sir George Hampson, from Cartwright, Manitoba.

Genitalic Slides: 1, Franklin Co., N. Y. (McKnight); 1 Stockton, 1 Vineyard, 2 Provo, 5 Deer Creek, Utah; 1, So. Utah; 1, Colo. (Snow); 4, Glenwood Springs, Colo.; 1 Las Vegas, 1 Jemez Springs, N. Mex.; 1, Truckee, Calif.; 1, Miles City, Mont.; 1, Calgary, Alta.; 1, Cartwright, Man.; 1, Duncans, Vanc. Total, 22.

This "species" has already been discussed at some length and detail under the heading Group Placida. While very heterogenious, its characters appear to be as follows: Antennae minutely ciliate with longer setae;—all lines usually double and clearly defined ;reniform and orbicular often large, usually clearly defined. Orbicular with a strong tendency to be very irregular ;seldom small and round. Usually with at least a trace of the median shade, which is frequently clear and pronounced. The median shade is seldom visible in any allied species except *scopeops,* from which it can be distinguished by its smoother, stubbier appearance and usually irregular orbicular.

LAMPRA PLACIDA ab. *MINIMALIS,* Grt.

1879. Grt., No. Amer. Ent., I, 45, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 19, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 52, *Rhychagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal., B. M., IV, 639, pl. LXXVII, f. 14, *Triphaena.*
1903. Holl., Moth Book, p. 178, pl. XXI, f. 21, "red form *placida*" on plate; *Rhynchagrotis.*
1908. Sm., Can. Ent., XL, 223, *Rhynchagrotis.*

AGROTIS MINIMALIS, n. s.

Allied to *placida,* but reddish like *cupida.* Fore tibiae unarmed. Orbicular small, round, paler with dark center; reniform small, dark. Median shade diffuse, continuous, evident below reniform. Lines single, blackish, followed by pale shades. Subterminal space dark red and contrasting with pale terminal. A terminal row of dots, fringes concolorous. Head and thorax reddish, concolorous. Abdomen fuscous, flattened, with reddish anal hairs. Wings beneath fuscous, shaded with red, with common line distinct on secondaries, on primaries marked on costa. Discal dots better marked on hind wings. Palpi black on sides. *Expanse* 33 ^{mm}.

Type Locality: Idaho Springs, Colo.
Number and Sexes of Types: ♀.
Types in: British Museum, 1 ♀ "Type"; Snow Collection, 1 ♀ "Cotype" (?).
Specimens Examined: See Text.
Genitalic Slides: 3, transitional to *placida,* Wallace, Idaho.

In his original description Mr. Grote mentions various characters such as "reddish," "median shade diffuse"; "reniform small";

"lines single"; "s.t. space dark red and contrasting pale terminal." All of these characters are to be found in Western "*placida.*" Only very occasionally are they all found in the one specimen. The author has before him a female specimen from the Snow Collection, marked "Agrees with Type, G. F. H." (Sir George Hampson). This was probably one of the original type lot. Another Colorado specimen approaches it closely except that the lines are double. This specimen was compared with the "Cotype" in the Snow Collection by Dr. McDunnough. The author has a female specimen from Wallace, Idaho, which is almost identical with the last mentioned, but is darker in color. Some males from Wallace, Idaho, are transitional forms between *placida* (Eastern) and *minimalis,* showing in a series all the peculiar characters assigned to that "species." The genetalia of three of these were examined, and except for minor individual variation, found practically identical with Eastern *placida. Minimalis* is simply an aberration with single lines, and of the lighter shade ("reddish") more common in the females of the group than the males.

GROUP NEFASCIA

This is a more or less heterogenious group; distinguished by the smooth thorax and collar; antēnnae ciliated with longer setae to the joints and with the orbicular small and round, usually clearly outlined. The reniform is moderate to small, and typically kidney-shaped. Species in this group are very likely to be confused and are best separated on genitalic characters. The superficial key will serve to place typical specimens.

Superficial Key to the Nefascia Group

I.—Color some shade of yellow or orange, thorax much darker .... *duanca*

II.—Not so,—collar and thorax concolorous,

A.—Small, (size of *placida*); color always dark; wings very narrow and elongate; orbicular minute, ringed with whitish; wings very smoothly scaled, with a pronounced satiny luster ;often slightly tinged with rufous; a very "clean-cut" appearance, male and female identical—(aberrant) .... *duanca*

B.—Typically small, wings with a banded appearance due partially to dark filling in of s. t. space; wings not smoothly scaled ;appearance not as clean cut due to a general scattering of dark scales over the ground. *nefascia*

C.—Size moderate, resembling small suffused *alternata;* maculation usually not as plain as *nefascia; orbicular* usually minute; ground color dull gray to reddish .... *forbesi*

D.—Size moderate to large; male resembling large *nefascia;* female resembling either large *nefascia* or *alternata;* antennae at base so heavily scaled setae and cilia are obscured.......... *barnesi*

Genitalic Key to the Nefascia Group

I.—Sacculus large and lobate; arm of valve slender, so that when spread out the arm appears as a mere crook from beneath the sacculus..*nefascia*

II.—Not so,—

A.—Valves short, without much curve, and with a tendency to be pointed; spine of penis on a heavy chitenous hump ....*duanca*

B.—Not so,—spine of penis not on a chitenous hump,

a.—Penis showing a decided, peculiar ribbing; comb (of penis) small, spine large and long............*forbesi*

b.—Penis not showing the pecular ribbing; comb modified into a huge plate with "teeth" at the end and with a decided tendency to be projecting from the aedoeagus; spine missing............*barnesi*

LAMPRA BARNESI, sp. nov.
LAMPRA BARNESI, n. sp.

Ground color variable. Head, color, thorax and ground color of primaries usually concolorous; the head and collar rarely lighter. Antennae simple, ciliated, with longer setae to the segments; but so heavily scaled at the base that the setae are obscured. In this it differs from *alternata, anchoceliodies, cupida,* and *nefascia.* Palpi black at the sides, paler at the tips. Orbicular always round and small; usually filled with ground color, but in general clearly outlined by pale line. Reniform moderate, constricted in the center ;usually dark at the top and base, with the median area concolorous with the ground. Ordinary lines double and darker than the ground whereas the space between them is usually lighter. S.t. similar to *cupida,* and with no trace of the W-mark. In the male the s.t. area is darker; while the terminal area is lighter, than the ground and often with a blueish tinge: usually dark and resembling a large *nefascia.* Some females closely resembling the males; others varying through shades of tan, reddish and clay; often resembling *alternata.* Secondaries dark fuscous to black, lighter at the bases. Fringe white at the tips; ocherous at the base; the two areas separated by a clear brown line.

In short, a very variable species in color and maculation, especially in the females. Genitalically it is quite distinct and fairly constant, from all localities. The feature distinguishing it from all other species of the genus is that on the tip of the visica of the penis is a large chitenous plate spined mainly at the end, and normally *protruding* from the oedoeagus.

It appears to be a common species and widely distributed over the southwestern United States. The types are all from Arizona, but other specimens of apparently the same species are from California and Utah.

Type Locality: Holotype ♂, White Mountains, Ariz; allotype, Palmerlee, Ariz; Paratypes from, White Mountains, Redington, Palmerlee, Phoenix, Paradise, Mohave Co., Yavapai Co., Huachua Mountains, Tucson, Senator and Prescott, Arizona.

Numbers and Sexes of Types: Holotype ♂; Allotype ♀; 37 ♂, 49 ♀ Paratypes.

Types in: Barnes Collection.

Specimens Examined: See text.

Genitalic Slides: Holotype and 6 Paratypes, as follows: 2, Paradise; 1, Yavapai Co.; 1, Redington; and 1, Palmerlee, Arizona. Other slides from: 2, Provo, Utah; 1, Vineyard, Utah; and 1, transitional to form *nevadensis,* from Mission San Jose, California.

LAMPRA BARNESI, form *NEVADENSIS*, f. nov.

1912. B. & McD., Cont. Nat. Hist. Lep. N. A., I, # 4, pl. 22, f. 10, *Rhynchagrotis*, sp. undet.

LAMPRA BARNESI form NEVADENSIS, f. nov.

This is the very light form figured in the Contributions to the Natural History of the Lepidoptera of North America, Vol. I, No. 4, plate 22, figure 10, by Barnes and McDunnough. This excellent figure necessitates no description other than to state that the insect is even lighter than it appears in the photograph. It resembles the typical form, from which it differs in its being much lighter and in having the markings almost lost in the general ground color.

Type Locality: Esmeraldo Co.; and Reno, Nevada.

Numbers and Sexes of Types: 2 ♀ Cotypes.

Types in: Barnes Collection.

Specimens Examined: only the types, but several transitional specimens, from Arizona and California.

Genitalic Slides: See heading Genitalic Slides under *L. barnesi.*

LAMPRA FORBESI, sp. nov.

LAMPRA FORBESI, n. sp.

Ground color variable, but dull; often smoky gray, sometimes with a reddish tinge. Head, collar, thorax, and ground color of primaries concolorous. In the gray specimens the body is also concolorous; in the reddish ones, of the same shade as the base of the secondaries. Ordinary spots distinctly outlined by a clear, light, ochreous line, and similar to *nefascia.* Orbicular with a tendency to minuteness as in *duanca* and filled with ground color. Terminal area of primaries paler than ground, with a slight blueish cast; s.t. area slightly darker, especially at the costa, which is marked with black points at the basal, t.a., and t.p. lines. Primaries shaped much as in *alternata;* but finely and smoothly scaled, giving the wings a silky luster. More or less of a scattering of black scales over the primaries. Palpi black at the sides, lighter at the tips. Antennae minutely ciliated, with longer setae from each joint. Thorax apparently smooth, but on careful examination with the barest *trace* of a spreading, divided, crest. In most specimens this cannot be seen. Tip of the abdomen of male relatively broad; of female almost truncated and much depressed. The peculiar *heavy* ribbing of the penis separates it immediately from all other species in the genus.

Type Locality: Holotype ♂, Stockton, Utah; Allotype ♀, Stockton, Utah; Paratypes, 3 ♂ Stockton, 1 ♀ Stockton, 1 ♀ Provo, 2 ♀ Eureka, Utah. Total, 9.

Number and Sexes of Types: as above.

Types in: Collection Dr. William Barnes.

Specimens Examined: tybe series only.

Genitalic Slides: Holotype and 2 Paratypes.

LAMPRA DUANCA, Sm.

1908. Sm., Can. Ent., XL, 228, *Rhynchagrotis*.

RHYNCHAGROTIS DUANCA, n. sp.

Blackish-smoky; head and collar faded, more yellowish, secondaries with a brownish shade. Primaries with all the transverse maculation lost or barely traceable; ordinary spots small, traceable by slightly paler annuli.

Expands—1.22–1.36 inches = 30–34 mm.

Habitat—Stockton, Utah, IX, X; California.

Two ♂'s and 3♀'s in rather unsatisfactory condition, but obviously different from anything else in this series. It is narrower winged than *nefascia* and with the maculation almost all lost. I have a pair of specimens from Montana, which are practically the same, but there is enough question about it to prevent my placing them in the type series.

Type Locality: Stockton, Utah; and California.

Number and Sexes of Types: 2♂, 3♀.

Types in: Holotype ("Male Type"), Stockton, Utah; Allotype ("Female Type"), Stockton, Utah; 1♀ Paratype ("Cotype"), Stockton, Utah; Collection Rutgers College; 1♀ Paratype ("Cotype"), Stockton, Utah, Barnes Collection.

Specimens Examined: Total 33; from Provo, Stockton and Eureka, Utah; Esmeralda Co., and Reno, Nev.; Truckee and Shasta Retreat, Calif.; Prescott, Ariz.; 1 Paratype and 16 Topotypes from Stockton, Utah.

Genetalic Slides: 3, from Stockton, Utah.

Dr. Smith's description may be modified as follows: Ground color blackish-smoky, often with a reddish tinge. Head and collar any shade of yellow to orange. Collar with or without a transverse dark band; or exceptionally the collar may match the ground color of the primaries. Transverse maculation of the primaries traceable but faint. Ordinary spots small and traceable by whitish annuli. Expanse 1.0-1.36 inches. With a distinct smooth scaled, clean-cut appearance, and a beautiful silky luster. Slightly narrower winged than *nefascia*.. Antennae finely ciliated with longer setae to the joints.

LAMPRA NEFASCIA, Sm.

1908. Sm., Can. Ent., XL, 227, *Rhynchagrotis*.

RHYNCHAGROTIS NEGASCIA, n. sp.

Similar to *placida* in size and general appearance, but with less trigonate and more stumpy primaries. The absence of a distinct median shade has been already noted (*), and, in addition, the ordinary spots are smaller, the reniform especially tending to become narrow, oblong, with the angle rounded rather than kidney-shaped. The secondaries in both sexes are very evenly blackish, whereas in *placida* they are decidedly paler at the base, and in no case evenly blackish. The primaries have the appearance of being more densely scaled, and while finely powdered, appear more even in general tint.

There is a large series of both sexes before me from Ft. Wingate, New Mexico, and another, collected by Mr. Buchholz, from Yavapai Co., Arizona. Altogether of spread material there are 35♂'s and 47♀'s showing a remarkable uniformity in general characteristics, while yet the terminal space is contrastingly blue in some examples, nearly concolorous in others, and the predominating shade may range from creamy-luteous to brick-red in one direction, and smoky or gray-brown in the other, the ordinary spots are usually a little darker and outlined by rather broad annuli of the ground color.

TYPE LOCALITY: Fort Wingate, N. Mex., and Yavapai Co., Ariz.

NUMBER AND SEXES OF TYPES: 35 ♂, 45 ♀.

TYPES IN: Holotype ("Male Type"), Fort Wingate, N. Mex.; Allotype ("Female Type"), Fort Wingate, N. Mex., 3 ♂, 3 ♀, Paratypes ("Cotypes"), Fort Wingate, N. Mex., and Yavapai Co., Ariz., Collection Rutgers College: 2 ♂, 1 ♀, Paratypes ("Cotypes), Ariz., Yavapai Co., Ariz., and Fort Wingate, N. Mex., Barnes Collection.

SPECIMENS EXAMINED: A very long series of both sexes from: Yavapai Co., Ariz. (Buchholz); Deming, Fort Wingate and Jemez Springs, N. Mex.; Stockton, Provo and Deer Creek, Utah; Hunters, Wash.; Duncans, Vanc.; Verdi, Nev.; Glenwood Springs, Colo.; Nellie, Loma Linda and San Bernardino Co., Calif.; Prescott, Ariz.

GENETALIC SLIDES: 1, Nellie, Calif.; 1, Loma Linda, Calif.; 2, Provo, Utah; 1, Duncans, Vanc.; 1, So. Ariz.; 1, Prescott, Ariz.; 1, Hunters, Wash.; 1, Stockton, Utah; 1, without data.

(*) Dr. Smith says, under heading "*Rhynchagrotis placida*, Grt.": "This specific name has served as a blanket for all narrow-winged forms. . . . There are really two forms concerned, the type *placida* with an obvious median shade line in both sexes, and the other without this character." He was wrong in considering that "*placida*" always has the median shade. There is usually at least a trace of it in about 80 per cent of the specimens of "*placida*," but that is as far as it goes. As stated under the heading Group Placida, there is no single character or set of characters, genetalic or otherwise, that will serve to separate "*placida*" from the rest of the genus.

The name *negascia* in our lists must change to *nefascia*. Smith intended it to be *nefascia*. His "f" is made peculiarly similar to a "g," but is plainly an "f" on three "cotypes" in the Barnes Collection. The spelling *negascia* instead of *nefascia* is clearly a typographical error, as on page 471 of Can. Ent., XL, under the heading "Corrigenda," is "Page 227, line 4 from bottom, for *negascia* read *nefascia*. Fortunately on page 222 of Smith's paper, five pages before this error is at least enough of a description of *nefascia* to hold the name in case of dispute. Quote: "There comes a series of species with somewhat elongate, subparallel wings, with rounded or stumpy outer margins. They are all variable, and it is difficult to divide them on exclusive characters. I include *nefascia, duanca,* . . . *cupidissima*."

Dr. Smith's original description of *nefascia* is clear and concise and exactly corresponds to the series before the author. A point that might be added is that the antennae are finely ciliated with longer setae from the segments. The genetalia show but little variation. Their most conspicuous feature being a very slim curved "arm" projecting from a huge saculus (the valve); best visualized by a glance at the figure.

GROUP VARIATA

This group contains two species—*variata* (with synonym *varix* and aberration *orbis*) and *scopeops*.

It is readily distinguished from all other groups in the genus by its usually peculiar motted appearance produced by a gray-blue-white underlay of smaller scales, combined with the transverse markings being normally scaled with the same color, when visible.

Variata is at once distinguishable by its large size and broad wings. In this it resembles *alternata*. In character of maculation it somewhat resembles *barnesi,* while in the bluntness of its primaries it resembles *trigona*.

Scopeops approaches *variata* in maculation, but its wings are narrower, and it is a smaller insect. An aberrantly small *variata* may be equal in wing expanse to a large *scopeops,* but if so its wings are broader. They appear to be genetalically distinct.

Superficial Key to the Variata Group

I.—Size small to moderate, 32 to 36^{mm}. Orbicular and reniform usually outlined clearly by a fine sharp line, markings bright, (wings *appearing* narrow) (N. Calif. to B. C. only) .... *scopeops*

II.—Size moderate to large, usually large, 36 to 42^{mm}. Orbicular and reniform outlined with a suffused line, sometimes fading into the ground color, (wings appearing broad) (N. Mex. to B. C.) .... *variata*

The blue underlay not showing; appearing concolorously drab or pale olive fuscous .... ab. *orbis*

Genitalic Key to the Variata Group

I.—Edge of sacculus a smooth even curve; ampulla of clasper not hidden, arising completely outside of the sacculus on the valve; chitenous retractile plate of penis spined on side .... *scopeops*

II.—Edge of sacculus not so,—indented; ampulla of clasper with base hidden; chitenous retractile plate of penis spined at end only .... *variata*

N. B.—The student is urged to note the fact that the genitalia in this group are variable and that the author has examined only two slides of *scopeops*—the only two males in the Barnes Collection.

LAMPRA VARIATA, Grt.

1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 83, pl. 4, f. 12, *Agrotis.*
1882. Grt., New List, p. 24, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., XXI, 155, *Agrotis.*
1889. Butl., Trans. Ent. Soc. London, 382=*phyllophora (Amathes).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 22, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 53, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 58, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 637, pl. LXXVII, f. 11, *Triphaena.*
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*

VARIX.

1876. Grt., Bull. Buff. Nat. Sci., III, 83, *Agrotis*.
1882. Grt., New List, p. 24, var. praec.?
1889. Butl., Trans. Ent. Soc. Lond., 382, *phyllophora (Amathes)*.
1890. Sm., Bull. U. S. N. M., XXXVIII, 22=*variata (Rhynchagrotis)*.
1893. Sm., Bull. U. S. N. M., XLIV, 53=*variata (Rhynchagrotis)*.
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 58=*variata (Agrotis) (Lampra)*.
1903. Hamp., Cat. Lep. Phal. B. M., IV, 637=*variata (Triphaena)*.

AGROTIS VARIATA n. s.

♀.—Anterior tibiae unarmed; terminal space pale. This species differs by the more irregular, pale powdery s.t. line, relieved from the pale terminal shading by the ground color of the wing obtaining behind it. The dark fore wings are stained ocherous. The geminate lines, with pale included shades, are well defined and inaugurated by black costal dots. Stigmata concolorous, ill defined; orbicular round, moderately large; reniform upright, narrow; both defined by narrow pale yellowish annuli, a diffuse pale powdering over the place of the claviform. Collar, head and palpal tips grayish; palpi black at the sides; thorax like fore wings. Hind wings fuscous with interlined fringes; beneath with common line *straightly* marked with black on costa of primaries.

California, No. 4573. Expanse, 33^{mm}.

Type Locality: California.

Number and Sexes of Types:

Types in:

Specimens Examined: Total, 97; from, Truckee, Eldridge, Camp Baldy, Mission San Jose, and Shasta Retreat, Calif.; Reno, Nev.; Glenwood Springs and Durango, Colo.; Colo. (Bruce); Provo and Vineyard, Utah; Senator, Ariz.; Fort Wingate, N. Mex.; Hot Springs (Green River) and Hunters, Wash.; Kaslo, B. C. Also one specimen, compared with type of *varix*, by Sir George Hampson; from, Provo, Utah.

Genetalic Slides: 1, Truckee, Calif.; 1, Hot Springs, Wash.; 1, Vineyard, Utah.

AGROTIS VARIX n. s.

♀.—Like the preceding, with pale terminal space. Of a pale drab or gray olive fuscous. Markings much like the preceding, from which it seems to differ in color, in the greater width of the geminate lines, and particularly in that beneath the common line is outwardly *obliquely* marked with black on the costa of primaries. Generally paler and less distinctly marked than *variata*.

Vancouver Island, No. 5615. Expanse, 35^{mm}.

Type Locality: *Vancouver*.

Number and Sexes of Types: 1 ♀.

Types in: British Museum.

Specimens Examined: See tabulation under *variata*.

Prof. Grote, in 1883—Proc. Am. Phil. Soc., "Introduction to the Study of N. A. Noctuidae," leaves *varix* out of account entirely. In 1895, Abh. Nat. Ver., Bremen, he definitely sinks it as a synonym of *variata*. Sir George Hampson, Cat. Lep. Phal. B. M., IV, 637, has the type before him and follows this procedure. The author has a specimen before him matched with the type of *varix* by Hampson, and it appears to be merely a form of *variata;* a form which is intermediate in the range of variation of that species, and does not deserve a name.

The antennae of *variata* are very heavily scaled, and with but few cilia showing. Longer setae appear on each segment in addition to the short cilia.

Utah forms are mainly reddish in color, with a gradual darkening through olivaceous in California forms, to grays in Northern California, Washington, and British Columbia, with all intergrades.

This species is in a decidedly unstable evolutionary state, for while the California and Washington specimens have almost identical genetalia, the Utah specimen examined has a shorter, heavier uncus, and lacks a spine on the penis. In all specimens the "teeth" of the chitenous penis-plate arose from the end, although otherwise variable. For the armature of the penis to vary as greatly as this is decidedly surprising; but there is not the slightest difference in the appearance or structures of the adults. Unless a larval difference is found the Utah and California specimens must go together as one unstable species.

LAMPRA VARIATA ab. *ORBIS,* Grt.

1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 83, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144=*cupida-cupidissima? (Agrotis);* p. 155, distinct?
1890. Sm., Bull. U. S. N. M., XXXVIII, 24=cupidissima *(Rhynchagrotis).*
1891. Grt., Can. Ent., XXIII, 150 (no genus).
1893. Sm., Bull. U. S. N. M., XLIV, 53,=*variata (Rhynchagrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 58, var. *variata (Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 637,=ab. 1 *variata (Triphaena).*

AGROTIS ORBIS n. s.

♀.—Entirely concolorous drab or pale olive fuscous, shining; s.t. space barely differentiated by its darker tint. All the lines faint, geminate as in allied species. Distinguished by its reduced, round, complete orbicular distinctly margined. Head and thorax concolorous. Hind wings concolorous fuscous with interlined fringes; beneath with discontinued common line.

Expanse, 38^{mm}. Sierra Nevada, Cal., No. 4580. Mr. Hy. Edwards.

The species *orbis, varix, laetula, cupidissima, observabilis, variata,* seem to belong to the Eastern group represented by *cupida, alternata,* and *brunneipennis,* having a flattened abdomen and unarmed tibiae. Clandestina (Ogygia) has the fore tibia armed.

Type Locality: Sierra Nevada, California.

Number and Sexes of Types: 1 ♀.

Types in: British Museum.

Specimens Examined: None answering the original description of *orbis*—several transitorial forms of *variata.*

Dr. Smith saw the type of *orbis* in the British Museum and refers to it (Bull., U. S. N. M., XLIV, 53) as "simply *variata* without the bluish scales." Sir George Hampson had the type before him when he wrote the Cat. Lep. Phal. B. M., IV, 637, designating *orbis* as ab. 1 of *variata.*

It appears to be only an aberration of *variata.* Specimens before the author match the description with the exception of the terminal area of the primaries. The type locality, "Sierra Nevada, Cal., Mr. Hy. Edwards," makes it probable that the type came from the vicinity of Truckee, Calif. A long series of specimens is before the author from Truckee (Miss X. McGlashan), and none match identically Grote's description of *orbis.*

These facts, coupled with Mr. Grote sinking his own name, *orbis*, as a variety of *variata* in 1895 (Abh. Nat. Ver., Bremen, XIV, 58), seem conclusively to point to *orbis* as a mere aberration.

LAMPRA SCOPEOPS, Dyar.

1904. Dyar, Can. Ent., XXXVI, 31, *Rhynchagrotis*.
1908. Sm., Can. Ent., XL, 227, *Rhynchagrotis*.

RHYNCHAGROTIS SCOPEOPS, n. sp.

Allied to *variata* and *alternata*. Dark violaceous brown, shading to dull clay color at bases of wings and on thorax. Lines geminate, crenulate, as in *alternata*, but distinct; orbicular and reniform distinctly bordered with whitish rings, filled with the ground color. Terminal space bluish ashen, contrasted; margined narrowly and fringe dark.

Described from 6 specimens, Kaslo, B. C.

U. S. National Museum, type No. 7327.

TYPE LOCALITY: Kaslo, B. C.

NUMBER AND SEXES OF TYPES: 6 ♀ Cotypes.

TYPES IN: National Museum (4 ♀); Barnes Collection (1 ♀).

SPECIMENS EXAMINED: 1 ♀ "type" (No. 7327, U. S. N. M.); 2 ♀, Duncans, Vancouver Island; 1 ♀, Shasta Retreat, Siskiyou Co., Calif.; 1 ♀, Pullman, Wash.; 1 ♂, Tehachapi, Kern Co., Calif.; 1 ♂ (Topotype), Kaslo, B. C.

GENITALIC SLIDES: 2, made from the above males.

Similar to *variata;* distinguishable by its usually smaller size; usually brighter and cleaner cut markings, and the primaries at the outer margin narrower than in runty *variata* of the same wing spread. It is distinctly possible that this may be a northern race of *variata;* but this seems unlikely, as *variata* from Kaslo (type locality of *scopeops*), Northern California and Washington are before the writer, and agree with southern *variata* in structure and markings. It may be well to note again that northern *variata* produces more dark and fewer light forms than southern; whereas all the specimens of *scopeops* seen by the author were light forms similar to southern *variata*.

The genetalia of *scopeops* seem to vary along the same general line as that of *variata,* as well as can be judged from two specimens of a species with such a restricted habitat.

From this evidence it would seem that *scopeops* and *variata* came from a common ancestry, or arose one from the other; and that sufficient time has not elapsed to stabilize the genetalia of the two species. It is probable that *variata* arose from *placida* through forms similar to *scopeops,* as some specimens of *placida* from British Columbia very much resemble *scopeops*.

In the specimens of *scopeops* examined, while the uncus is similar, there is a vast difference in the armature of the penis. A topotype had the penis armed with a plate, on the sides of which were about five minute "teeth," one medium and one large "tooth," whereas a specimen from Kern Co., California, had the same structure armed with two medium and two large "teeth." These "teeth" appear to arise laterally on the edge of the plate (instead of at the end of it, as in *variata*).

GROUP ALTERNATA

Alternata is the sole species placed in the group. It is distinguished by the large sized, square cut primaries; the orbicular large, usually elongate and oblique; the reniform large and broad, with a tendency to constrict in the center. Both spots are clearly outlined and margined by a whitish clear-cut line. Terminal area usually lighter than the ground, which may be any color from tan to gray. The s.t. line is peculiar to the species, having two large "teeth" with an indented area between and the last tooth subdivided into a W-mark (similar to the W-mark of Smith in Hadena and Mamestra, and Hampson in Trachea and Polia). Thorax smooth, without sign of a crest. Antennae ciliated, with longer setae on each joint. The ampulla of the clasper is small and membraneous. There is very little variation in the genitalia.

Alternata appears to be a widely distributed, common species, in a very stable evolutionary state.

LAMPRA ALTERNATA, Grt.

1864. Grt., Proc. Ent. Soc. Phil., III, 526, pl. 5, f. 8, *Noctua.*
1869. Grt., Trans. Am. Ent. Soc., II, 309, *Agrotis.*
1874. Grt., Can. Ent., VI, 15, *Cerastis.*
1874. Grt., Can. Ent., VI, 214, *Agrotis.*
1878. Grt., Can. Ent., X, 235, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., XXI, 155,=*cupida* var., *(Agrotis).*
1889. Butler, Trans. Ent. Soc. Lond., 382,=*phyllophora, (Amathes).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 23, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 53, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 637, pl. LXXVII, f. 12, *Triphaena.*
1903. Holl., Moth Book, p. 178, pl. XXI, f. 20, *Rhynchagrotis.*
1908. Sm., Can. Ent., XL, 286, *Rhynchagrotis.*

NOCTUA ALTERNATA, nov. sp. (Plate 5, fig. 8 ♀)

Anterior wings pale dull ochraceous, slightly olivaceous, subterminal space brownish, with a purplish lustre; terminal space very pale ochraceous, ordinary lines geminate, distinct, brownish. Basal, sub-basal and median spaces uniform dull dark ochraceous, slightly paler at extreme base and toward the costa; median space partially shaded with a purplish lustre. Basal half-line geminate, distinct, brownish; transverse anterior oblique, geminate, with a simple subcostal dentation, thence undulate to internal margin. Ordinary spots very distinct, surrounded by paler annuli, with brownish centers, the reniform slightly shaded with ferruginous; transverse posterior line geminate, interrupted, nearly straight, but little arcuated at the disc, followed by minute black dots on the veins, which latter are paler in the subterminal space. Subterminal space dark brownish, with a purplish luster, distinctly relieved from the terminal space by the subterminal darker marginal line, which is lost inwardly, owing to the dark color of the subterminal space. Terminal space paler than the median and basal spaces, with a series of terminal blackish dots between the veins, fringes dark. Posterior wings uniform blackish cinereous, hardly darker shaded along external margin, immaculate; fringes paler with a blackish central line. Head and prothorax rather bright ochraceous; tegulae and thorax concolorous with anterior wings; abdomen cinereous above, with reddish anal tuft and shaded with the same color beneath. Under surface of anterior wings reddish along the costa and external margin, rest of the

wing blackish cinereous, with a median transverse blackish line nearly straight and quite distinct; under surface of posterior wings irrorate with black scales, shaded with reddish, especially on the costa, and with a median transverse distinct black line and discal spot. Exp. ♂, 1.40 inches.

Habitat.—Middle States. (Coll. Ent. Soc. Phila.)

On examining the ornamentation of this species it is seen to be very similar to that of *N. cupida*, while the coloration is very different. It is a slightly larger and more robust species, the reniform spot is relatively larger and nearly concolorous with the orbicular, while the ordinary spots are dissimilarly colored in *N. cupida*.

Type Locality: Middle States.

Number and Sexes of Types:

Types in: Am. Ent. Soc. Phila.

Specimens Examined: Total, 18 ♂, 50 ♀; from, Ottawa, Can.; Meach Lake, Quebec; Hymers, Ontario; Cartwright, Manitoba; Battle Creek, Mich.; Columbus, Ohio; Oconee, Ill.; Lafayette, Ind.; Iowa; Provo, Stockton, Deer Creek and Vineyard, Utah; Denver, Colo.; Glenwood Springs, Colo.; Prescott, Ariz.; Plainfield and Brown's Mills, N. J.; New Washington, New Brighton and Bethlehem, Pa.; Hudson, Ithaca, and Flushing, N. Y.; Magnolia and Concord, Mass.; Center, N. Y. (Hill); Douglas Co., Kansas (Snow); New Mexico (Snow). Also one female, compared with type, by Dr. McDunnough, from Magnolia, Mass. (Thaxter).

Genetalic Slides: 1, Magnolia, Mass. (Thaxter); 1, New Brighton, Pa.; 1, New Washington, Pa.; 1, Brown's Mills, N. J.; 1, Lafayette, Ind.; 1, Columbus, Ohio; 1, Provo, Utah; 2, Glenwood Springs, Colo. Total, 9.

GROUP INSULARIS

This group contains one species and one form, viz: *insularis*, Grt., with form *confusa*, Sm. It differs from the Exsertistigma Group in that the cilia of the antennae are very long and arranged in blocks on the segments, giving an almost fasciculate appearance; the basal segments presenting a sublamellate appearance when viewed under a strong lens. The setae are not visibly present at the bases of the antennal shafts.

Dr. Smith was in error in sinking *insularis* as a synonym of *formalis*. Had he had *insularis* correctly placed, he would probably never have named the *confusa* form. He did recognize the fact that dark forms of the same species occurred, as proven by the fact that a specimen of *morrisonistigma* resembling true *insularis* was determined by him as *confusa* for Mr. George Franck, and which eventually reached the Barnes Collection, via the author.

Confusa is merely a red-brown form of *insularis*. In general it is more southern in habitat, but is found in Vancouver with the typical form. Other specimens from Vancouver and Manitoba are intermediate.

The maculation of specimens of this group are spoken of by past workers as if they possessed a most remarkable stability. This is not true. The collar may vary from ashen through brown to black. It may be concolorous throughout or may have black tips and transverse markings. The orbicular is usually flaringly wide open to the costa, but not always so. The claviform is present in all specimens examined, but in some it is very distinctly margined, whereas in others the margining line has almost faded into the ground color.

Unfortunately we have no genitalic check, as the only male specimen of typical *insularis* seen by the author lacks a body. A female, compared with the type in the British Museum of *insularis*, by Sir George Hampson, is in the Barnes Collection, together with intermediates to *confusa* from Vancouver. A female, compared with the type of *confusa*, in the Tepper Collection, by Dr. McDunnough, leaves little room for doubt. Dr. Smith, in this instance, could scarcely have mixed his types, as typical *confusa* has no very close resemblance to anything else except *insularis*, and the "bright red-brown" of the original description at once places the form.

The female type in the Tepper Collection seems to be the only type of this form (*confusa*) now in existence, as a list of the types of the genus in the Brooklyn Museum, Smith Collection, and the National Museum, show no types of *confusa*. In Bull. U. S. N. M., XLIV, Smith states: "The types of this species are in the Tepper Collection."

Superficial Key to the Insularis Group

I.—Deep purple red-brown, presenting a very dark (blackish) appearance........insularis

II.—Bright red-brown, presenting a lighter appearance........form *confusa*

LAMPRA INSULARIS, Grt.

1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 82, *Agrotis*.
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis*.
1890. Sm., Bull. U. S. N. M., XXXVIII, 31, = *formalis* var. (*Rhynchagrotis*).
1893. Sm., Bull. U. S. N. M., XLIV, 55, = *facula* form (*Rhynchagrotis*).
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, = *formalis* var. (*Agrotis*) (*Lampra*).
1903. Hamp., Cat. Lep. Phal. B. M., IV, 632, = *formalis* (*Triphaena*).

AGROTIS INSULARIS n. s.

♀.—Purple red-brown with ashen costal region crossed by the geminate black transverse lines. Stigmata concolorous; cell between them and before the orbicular black. Reniform narrowly edged with pale. A black sub-basal curved dash. Course of the lines as in *exsertistigma*, collar ashen; thorax red-brown. Hind wings fuscous with interlined fringes. Allied to *exsertistigma;* differs in color and in the black lines, and in the more bent subterminal followed by pale points, as well as in the more rounded orbicular.

Expanse, 34mm. Vancouver Island, Mr. Hy. Edwards, No. 4643.

Type Locality: Vancouver Island.

Number and Sexes of Types: 1 ♀.

Types in: British Museum.

Specimens Examined: Total, 4 typical; from Duncans, Vanc., 1 ♂, 2 ♀, and 1 ♀, compared with type in the British Museum, by Sir George Hampson. Also 7 intermediates from Duncans, Vanc., Victoria, B. C., and Brandon, Manitoba.

Genitalic Slides: 1, intermediate to form *confusa*, from Brandon, Manitoba.

LAMPRA INSULARIS form *CONFUSA*, Sm.

1887. Sm., Proc. U. S. N. M., X, 452, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 37, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 57, *Rhynchagrotis.*
1894. Grt., Can. Ent., XXVI, 84 = *morrisonistigma (Agrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lept. Phal. B. M., IV, 632, pl. *LXXVII*, f. 2, *Triphaena.*
1908. Sm., Can. Ent., XL, 224, *Rhynchagrotis.*

A. CONFUSA Smith, sp. nov.

Bright red-brown; costa and collar broadly pale yellow; cell before and between the ordinary spots black; ordinary spots concolorous, narrowly annulate with pale yellow; claviform outlined in same way. T. a. line distinct, not crossing costal pale space, but incurved to base; t.p. line punctiform, indistinct, geminate, included space paler; s.t. line pale yellow, narrow, powdery, emphasized by the somewhat darker brown s.t. space. secondaries fuscous. ♂ genetalia essentially as in *crenulata.* Expands 1.5 inches ($38\text{-}39^{mm}$).

Habitat.—Washington Territory.

This is the form labeled *exsertistigma* by Mr. Grote in collection Graef and Neumogen, and Mr. Tepper also had a specimen associated with *binominalis* under the same title. The superficial resemblance between *binominalis* and *confusa* is very close, but the species are undoubtedly distinct. The black collar of *binominalis* is distinctive and the difference in the genitalia is strongly marked. Four specimens of ♂ and ♀ from Messrs. Graef, Tepper, and Neumoegen examined.

Type Locality: Washington.

Number and Sexes of Types: 4 specimens of ♂ and ♀.

Types in: Tepper Collection.

Specimens Examined: Total, 26; from, Duncans, Vanc.; Victoria, B. C.; Kaslo, B. C.; Arrowhead Lake, B. C.; Ft. Klamath, Ore.; Seattle, Wash.; Plumas Co., Calif. One specimen compared with the type in the Tepper Collection, by Dr. McDunnough, from Plumas Co., Calif.

Genitalic Slides: 1, Seattle, Wash.

GROUP EXERTISTIGMA

This is a very heterogeneous group; similar in this respect to "*placida.*" It is distinguished by its thoracic crest, chitenous clasper. and finely ciliated antennae in the male. Single specimens picked here and there throughout a series differ vastly in looks and markings. It is the author's opinion that there are no really valid species in the lot. The "lumper" is privileged to call them all one—the "splitter" to divide into species to his heart's content. There appear to be no good structural characters on which to base determinations. The antennae of *cupidissima* is nearest to that of *insularis,* but there seems a very gradual gradation down the series to the smaller forms, such as *niger.* To all practical purposes the genitalia are identical, with considerable variation to the ends of the valves, the tips of the clasper, and the vinculum. Some of the forms are so strikingly unlike in superficial appearance that it seemed impossible to place them together. A long series of most of the forms shows a gradual gradation to the nearest allied forms in all directions. Previous workers have used purely superficial

characters to separate them—ground color and maculation. Six specimens, presumably bred from the one batch of eggs, might well be placed in at least three different "species." Two of these have the collars concolorous with the primaries, barely tipped with black, whereas the others have a broad black band at the tips. This is not at all strange in view of the fact that *confusa-insularis* does exactly the same thing. As in *placida,* no single character seems to hold; nor does any set of characters remain a constant factor. Many of the forms have a slight genitalic difference—mainly in the tips of the valves, which are variable in all other species of the genus. As if a final proof—two genitalia of *cupidissima* (apparently the most distinct "species") proved different. Also two specimens apparently *niger;* a smaller, slimmer "species" proved different. Then to correlate one of these matched one *cupidissima,* except a very slight difference in thickness of one of the arms of the valves.

Perhaps there are definite species in the group. If so it seems impossible to separate them superficially or genitalically. The writer does not wish to "lump" extensively; nor to "split" on characters of proven unfitness. Therefore, until bred material be obtained in quantity it is proposed to place all names under the oldest, viz: *exsertistigma,* Morr. The other names, as far as practicable, will be retained as forms of a variable "species."

For mere convenience, due to the size of the group, the author treats it in three separate parts, viz: *morrisonistigma,* with synonyms *binominalis* and *crenulate; cupidissima* with ab. *laetula=distracta;* and the remainder of the group as a whole. There is absolutely no reason for so doing except that *morrisonistigma* and *cupidissima-laetula* were in enough of a confused state to require long, intricate discussion. It appeared best, due to past confusion, to gather together as much information as possible about the *morrisonistigma* and the *laetula-distracta* tangles; and then to let the reader see for himself the reasons for the disposition of the various names.

It is the writer's opinion that this group, like "*placida,*" is in an unstable evolutionary state, and that it is splitting up at the present time to form species.

Superficial Key to the Exsertistigma Group

I. Primaries with cell contrastingly black between stigma,

A.—Collar with broad black contrasting tips.

a.—Orbicular U-shaped, not flaringly open..*morrisonistigma*

b.—Orbicular flaringly wide open to costa,

a^1.—Smooth appearing; wings not heavily dusted with black scales..*facula*

b^1.—Wings heavily dusted with black scales........ ....*exsertistigma ab.*

B.—Collar without broad black contrasting tips, collar with or without a narrow black tip (size small to medium, transverse maculation obscure)........................*niger*

II.—Primaries with cell not contrastingly black between stigmata,

A.—Collar with broad black, or dark, contrasting tips,

a.—Ground color light, all transverse maculation distinct ....*exsertistigma*

b.—Ground color dark, all transverse maculation distinct ....*observabilis*

c.—Ground color variable, usually light, some transverse maculation not distinct..........................*formalis*

B.—Collar without broad black, or dark, contrasting tips,

a.—A "pepper and salt" appearance, due to a sprinkling of black scales, contrastingly, over ground color of primaries,

a^1.—Size moderate to large (size of *cupida*)........ ....*cupidissima*

b^1.—Size small (size of *placida*)

No black in cell..*laetula* } syn.
Blackish filling between stigmata............*distracta* }

b.—Not so; if black scales are scatered over the primaries they do not conspicuously contrast against the ground.

a^1.—Median space reddish, conspicuously contrasting with the t.a. and t.p. spaces, which are grayish (size small)..............................*meta*

b^1.—Median space not conspicuously contrasting (size moderate).

a^2.—Orbicular U-shaped,

a^3.—(Ground color deep purple-brown to black-brown). Wings normal, body heavy..*emarginata*

b^3.—Wings narrow, body slim, color dark to black often with a reddish cast............*inelegans*

b^2.—Orbicular flaringly open to costa,

a^3.—Wings narrow, color dark to black, often with a reddish cast..............................*inelegans*

b^3.—Wings broader (normal), color brighter red; often with a purplish tinge terminally, (type with a faint yellowish s.t. line)....*carissima*

The worker is warned that this key will only place typical specimens of the described forms.

LAMPRA EXSERTISTIGMA form *EXSERTISTIGMA,* Morr.

1874. Morr., Proc. Bost. Soc. Nat. Hist., XVII, 166, *Agrotis.*
1875. Grt., Can. Ent., VII, 26, = *alternata, (Agrotis).*
1875. Grt., Can. Ent., VII, 101, ? an sp. dist. *alternata, (morrisonistigma* ? in error) *(Agrotis).*
1875. Grt., Bull. Buff. Soc. Nat. Sci., II, 303, an sp. dist., *(morrisonistigma* in error) *(Agrotis).*
1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 79, *morrisonistigma* named, *(Agrotis).*
1887. Sm., Proc. U. S. N. M., X, 450, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 30, *Rhynchagrotis.*
1891. Grt., Can. Ent., XXIII, 151, *Agrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 55, *Rhynchagrotis.*
1894. Grt., Can. Ent., XXVI, 84, *Agrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *exsertistigma,* Morr. in part ? Coll. Tepper = *observabilis, (Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 631, pl. LXXVII, f. 1, *(Triphaena).*
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*

AGROTIS EXSERTISTIGMA, nov. sp.

Expanse, 37mm.

This species resembles the Eastern alternata Grote, but it can be separated by the following characters: Orbicular spot open above, not subquadrate, as in *alternata.* The median space is suffused with black. Claviform spot distinct and disconcolorous. The exterior line is drawn in below the cell; and lastly, the collar is black above, whitish and contrasting below.

Hab., California.

Dr. Smith appears to place *observabilis* and *formalis* as *exsertistigma,* specimens identified by him as such in the Barnes Collection.

Type Locality: California.

Number and Sexes of Types: 1 ♀.

Types in: Graef Collection.

Specimens Examined: 1, compared with type (Brooklyn), by Dr. McDunnough, from Mission San Jose, Calif.; 1, Alameda, Calif.; 1, Glen Alpine, Lake Tahoe, Calif.

LAMPRA EXSERTISTIGMA form *OBSERVABILIS,* Grt.

1875. Grt., Can. Ent., VII, 144, *Agrotis.*
1878. Grt., Bull. Geol. Surv., IV, 174, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1887. Sm., Proc. U. S. N. M., X, 451, ? pr. syn., *(Agrotis).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 34 = *exsertistigma ? (Rhynchagrotis).*
1893. Sm., Bull. U. S. N. M., XLIV, 55, = *exsertistigma, (Rhynchagrotis).*
1894. Grt., Can. Ent., XXVI, 84, = *exsertistigma, (Agrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 631, = *exsertistigma, (Triphaena).*

AGROTIS OBSERVABILIS, n. s.

♀.—Fore tibiae unarmed; middle and hind tibiae spinose. By the flattened abdomen allied to *cupidissima.*. Fore wings dark blackish brown, with the terminal space paler, somewhat olivaceous. As in *exsertistigma,* the orbicular is open, triangulate, broadly pale margined, fusing superiorly with a pale subcostal shade extending from the base of the wings above this spot. Unlike *exsertistigma,* the orbicular and reniform are black, the ground color of the median space about them being powdered with deep yellow. A black basal dash before the geminate, waved, t.a. line; the latter interrupted by the subcostal shade and with an interior pale shading. Claviform moderate, pale-edged. T.p. geminate, the inner line scalloped,

the outer even, enclosing a rather broad pale space; the line is very slightly sinuate, not depressed opposite the cell. Subterminal line nearly straight, dark, with a very pale powdery exterior shade. Subterminal space darker shaded on costa, relieving the costal dots distinctly. Terminal line dentate. Hind wings dark fuscous with pale interlined fringes. Beneath quite pale, faintly ruddy and subirrorate, with common exterior line fading toward internal margins and discal marks. Collar pale, edged behind with black; tegulae blackish. Expanse, 35mm. Hab., California (Behrens, No. 376).

This appears to be Dr. Smith's idea of *exsertistigma,* in part.

TYPE LOCALITY: California.

NUMBER AND SEXES OF TYPES: ♀.

TYPES IN: British Museum.

SPECIMENS EXAMINED: 1 Solano Co., 1 Calif. Co., 1 Yosemite, 1 Alameda Co. and 1 Middle, Calif.; 2, No lable, one of the last compared with the type by Dr. McDunnough.

GENITALIC SLIDES: 1, Middle, Calif.

LAMPRA EXSERTISTIGMA form *FORMALIS,* Grt.

1874. Grt., Bull. Buff. Soc. Nat. Sci., II, 61, *Agrotis.*
1878. Grt., Bull. Geo. Surv., IV, 174, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1887. Sm., Proc. U. S. N. M., X, 450, *Agrotis.*
1890. Sm., Bull., U. S. N. M., XXXVIII, 31, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 55, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen,-XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 632, pl. LXXVII, f. 3,. *Triphaena.*
1908. Sm., Can. Ent., XL., 224, *Rhynchagrotis.*

AGROTIS FORMALIS, Grote

♂.—An exceedingly dark and beautiful species, with silky squamation and somewhat flattened form and allied to our eastern *A. collaris* and *A. geniculata.* Middle and hind tibiae spinose. Dark intense blaskish brown. The collar has a narrow central pure white line, above which the phothoracic pieces are velvety black. Primaries with the costal edge broadly dark ashen to the inception of the t.p. line, absorbing the superior portion of the orbicular spot. Reniform gray, like the costal edge, moderate, with faint dark internal ring. Ordinary lines geminate, fine not very distinct or complete, black. The t.a. line waved, nearly perpendicular. The basal half-line visible on the gray costal edge. The t.p. line roundly but not greatly exserted opposite the cell, followed by minute black and white points on the subterminal space. Median space with a more ruddy brown tinge than the rest of the wing and like the thorax and tegulae. The faintly pale subterminal line is shaded with brown and the dark fringes are brown at base and show a faint interior line. Hind wings blackish without marks, with white-tipped fuscous fringes that show a broad interior line. Abdomen blackish. Beneath the wings are a little paler, irrorate, with a rather distinct blackish common line and black discal mark on the hind wings.

Expanse 35 mm. One fresh specimen, Mr. Behrens, California. Coll. of this Society.

This appears to be Dr. Smiths' idea of *exsertistigma,* in part.

TYPE LOCALITY: California.

NUMBER AND SEXES OF TYPES: 1 ♂.

TYPES IN: British Museum (Smith).

SPECIMENS EXAMINED: 2 Solano Co., 2 Yosemite, 7 Middle, 3 Stanislaus, 2 San Francisco, 1 Camp Baldy, 2 Mission San Jose, Calif.; 2 no label.

GENITALIC SLIDES: 1 Middle, 1, San Francisco, marked "Agrees with Type, G. F. H." Hampson); 2, Mission San Jose, Calif.

LAMPRA EXSERTISTIGMA form *FACULA*, Grt.

1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 82, *Agrotis.*
1878. Grt. Bull. Geol. Surv., IV, 174, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1887. Sm., Proc. U. S. N. M., X, 451, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 35, *Rhynchagrotis.*
1893. Sm, Bull. U. S. N. M., XLIV, 55=*formalis* var., *(Rhynchagrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18,=*formalis* var., *(Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 632=*formalis* ab. 1, *(Triphaena).*
1908. Sm., Can. Ent., XL, 224,=form norm. *formalis, (Rhynchagrotis).*

AGROTIS FACULA, n. s.

♀.—Dark purple brown; a slight ashen costal shade invades the stigmata. Recembles *formalis* in color and ornamentation. It differs by the black filling in on the cell; by the absence of the black band and central white line on the collar which is concolorous with the dark brown thorax, and only shows a superior black edging. The geminate lines occupy their usual position. The orbicular is open. There is an abdominal carina. Hind wings blackish fuscous. These species seem to lead into the cupida group of the genus.

Expanse, 34 mm. No. 4188, California. Mr. Hy. Edwards.

This appears to be Dr. Smith's idea of *formalis.*

Type Locality: Saucalito, San Joachim, California.

Number and Sexes of Types: ♀.

Types in: British Museum.

Specimens Examined: 1 Prescott, Ariz.; 2 Mission San Jose, 4 Solano Co., 3 San Francisco, 9 Middle, 1 Yosemite, 1 Truckee and 1 N. Calif.; 12, California; 1, Duncans, Vanc.; 2, Victoria, B. C.; 2 no label.

Genitalic Slides: 1, Prescott, Ariz.; 1, Mission San Jose, Calif.; 1, California, marked, "Agrees with type, G. F. H." (Sir George Hampson).

LAMPRA EXSERTISTIGMA form *NIGER,* Sm.

1903. Sm., Jour. N. Y. Ent. Soc., XI, 3, *Rhynchagrotis.*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 666 unknown. (Rhynchagrotis).
1908. Sm., Can. Ent., XL, 226, *Rhynchagrotis.*

RHYNCHAGROTIS NIGER, sp. nov

Ground color dull blackish with a purple tinge, all the maculation obscure except for the velvety black filling in cell before and between the ordinary spots. Head and thorax concolorous, collar with a more or less obvious transverse line or shade of yellowish scales, centrally. Thoracic anterior and posterior divided tufting prominent, the scales a little gray tipped. Primaries almost even in color, the costal region scarcely paler. Basal line geminate, velvety black. T.a. line geminate, included space a little paler, inner line obscure; outer line black, narrow, outcurved in the interspaces, as a whole a little outwardly oblique. T.p. line geminate, both lines even, obscure, feebly sinuate, the included space a little paler. S.t.

line vaguely indicated at costa, else practically not traceable. No terminal spots. Claviform vaguely indicated on one example. Orbicular V-shaped, concolorous, open to the costa, elsewhere bordered by black. Reniform moderate, kidney-shaped, concolorous, incompletely defined by pale scales except anteriorly where it touches the black filling of the cell. Secondaries smoky fuscous, hardly paler at base, fringes yellowish with a smoky interline; a vague discal lunule. Beneath blackish or smoky, paler and more powdery along the costa, both wings with a blackish outer line, secondaries with a discal lunule. Expands 1.28-1.40 inches–32-35 mm.

Habitat: Pullman, Washington, May 27; Moscow, Idaho, May 14; Prof. C. V. Piper.

Three female specimens in fair condition. The species resembles a small black *formalis*, or an *emarginata*, in which the pale outlines to the ordinary spots had disappeared and the black filling of the cell had been added. The course of the lines is different, however; there is no basal black mark or streak and the costal region is not in the least discolored. The specimens came with a series of *formalis* and *emarginata* and were at once easily recognizable as different.

Type Locality: Pullman, Wash.; Moscow, Idaho.

Number and Sexes of Types: 3 ♀ (original description).

Types in: "Male Type," Pullman, Wash.; "Female Type," Moscow, Idaho, Collection Rutgers College.

Specimens Examined: 1, compared with type, by Dr. William Barnes, from Pullman, Wash. (Topotype from C. V. Piper); 7, Pullman, Wash.; 2, Victoria, B. C.; 1, Duncans, Vans.; 3 Truckee, 1 Middle, 1 Alameda and 4 Camp Baldy, Calif.

Genitalic Slides: 1 Middle and 1 Camp Baldy, Calif.

LAMPRA EXSERTISTIGMA form *META,* Sm.

1903. Sm., Jour. N. Y. Ent. Soc., XI, 3, *Rhynchagrotis.*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 666, (unknown).
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*

RHYNCHAGROTIS META, sp. nov.

Ground color of head and thorax a somewhat rusty red, collar with or without transverse black scale lines. Primaries leaden gray with a vinous red suffusion, which predominated through the center of the median space, over the course of the s.t. line and on the fringes. Basal space to t.a. line mostly gray except along internal margin. Basal line geminate, black or brown, inner line complete, outer broken. T.a. line geminate, inner line not contrasting, outer line black or brown, as a whole outwardly complete, quite even and only a little outcurved in the interspaces. T.p. line geminate, rather evenly outcurved over the cell, very feebly incurved below; outer line obscure, inner line even or nearly so, brown or smoky. S.t. line a series of yellowish scale dots over which is a somewhat diffuse red shade band. There is a series of vinous red terminal lunules at the base of the fringes which are of the same color. No claviform is obvious in any specimen before me. Orbicular V-shaped, open to the costa, concolorous with the gray shading of the wing and defined only by the slight contrast between this and the vinous red shading below it. Reniform moderate in size, kidney-shaped, gray, defined in part only by the reddish shade which borders it more or less. Secondaries smoky, with a yellowish tinge toward base, fringes whitish, with a smoky interline. Beneath reddish-gray, powdery; primaries with disc smoky and with a more or less complete outer line; secondaries with a wavy extramedian line and a small discal spot. Expands 1.20-1.36 inches–30-34 mm.

Habitat: San Francisco County, California; Pullman, Washington, June 10, Experiment Station No. 295.

Three females in good condition. The California example has been in my collection for a long time and was looked upon as a suffused form until the specimens received from Prof. C. V. Piper made it certain that there is a good species. It has the wing form of *placida* and a casual resemblance to that variable species; but the open orbicular separates the new form at once and, among its associates in this character, I know of none with which it can be readily confused.

As between the specimens, that from California is the largest and has the least contrasts; not a black scale is on the primaries and the gray has a reddish tinge throughout.

Type Locality: Pullman, Washington; San Francisco, California.

Number and Sexes of Types: 3 ♀.

Types in: Holotype ♀ ("Type"), Pullman, Wash.; 1 ♀ Paratype ("Cotype"), San Francisco, Calif., Collection Rutgers College; 1 ♀ Paratype ("Cotype"), Pullman, Wash., Barnes Collection.

Specimens Examined: 1 San Francisco, 2 San Diego, 2 Middle and 1 Alameda Co., Calif.; 1 Paratype from Pullman, Wash.

(N. B.—No specimen in the series really compares favorably with this Paratype.)

LAMPRA EXSERTISTIGMA form *EMARGINATA,* Grt.

1876. Grt., Bull. Buff Soc. Nat. Sci., III, 82, *Agrotis.*
1878. Grt., Bull. Geo. Surv., IV, 174, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 33, ?=*formalis* var., *(Rhynchagrotis).*
1893. Sm., Bull. U. S. N. M., XLIV, 55, =*formalis, (Rhynchagrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18 =*formalis* var., *(Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 632, = *formalis, (Triphaena).*
1908. Sm., Can. Ent., XL, 226, *Rhynchagrotis.*

AGROTIS EMARGINATA, n. s.

♀.—Resembling *insularis,* but without pale margin to primaries. Abdomen flattened; this and the following species with *insularis* are nearest to *formalis.* Wings narrower than in *carissima.* Dark purple brown. Collar surmounted by a narrow black line. Stigmata concolorous, subequal., narrowly pale margined. Lines black, geminate, indicated on costal region, else faint, no black marks or shades. Orbicular open to costa. Hind wings dark fuscous with interlined fringes. Beneath paler; costal regions stained with purplish; common line and discal mark on hind wings. Abdomen dark fuscous above; purple stained beneath.

Expanse, 33 mm. No. 784 California, Mr. Hy Edwards.

Type Locality: Saucalito, San Joachim, California.

Number and Sexes of Types: ♀.

Types in: British Museum.

Specimens Examined: 2, Middle, Calif.; 1, San Diego, Calif.; 1, Yosemite, Calif, marked "like type *formalis var. emarginata* not *carissima*" in Sir George Hampson's handwriting.

Genitalic Slides: 1, Middle, Calif.

LAMPRA EXSERTISTIGMA form *CARISSIMA,* Harv.

1875. Harv., in Grote, Check List, 25, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 33, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 54, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 634, pl. LXXVII, f. 5, *Triphaena.*

AGROTIS CARRISSIMA, Harvey (n. s.)

♂. Allied to *formalis.* Head, thorax, fore wings and body beneath stained of a reddish purple over fuscous. Veins marked with blackish. Lines obsolete, geminate, marked by an included paler tint. Stigmata obsolete. Collar with a get black contrasting band. Beneath the wings are blackish, irrorate; hind wings paler with line and discal mark. California. Expanse 34 mm. L. F. Harvey.

Type Locality: California.

Number and Sexes of Types: 1 ♂.

Types in: British Museum.

Specimens Examined: 1 ♀ specimen from Middle, Calif., marked "*Carissima,* Harv. Type deeper in color, especially terminally, faint yellowish s.t. line.", in handwriting of Dr. McDunnough. Five other females from: 1 Truckee, 1 San Gabriel Mts., Los Angeles Co., 250 ft., 1 San Diego Co., 1 Calif. Co. and 1 Calif. (All from California.)

LAMPRA EXSERTISTIGMA form *INELEGANS,* Sm.

1890. Sm., Trans. Ent. Soc. Amer., XVII, 43, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 27, *Rhynchagrotis*
1893. Sm., Bull. U. S. N M., XLIV, 54, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 641, pl. LXXVII, f. 18, (more like combination drawing with duanca); *Triphaena.*
1908. Sm., Can. Ent., XL, 228, *Rhynchagrotis.*

AGROTIS INELEGANS sp. nov.

General color dull blackish brown. Head and palpi concolorous; collar with a reddish suffusion, more marked at the tip and extending to base of costa of primaries; thorax with base of patagiae and the tips of the small anterior and posterior tufts, also more reddish and slightly contrasting. Primaries with a slight reddish shading basally along costa, else quite uniform, save that the median space is a trifle darker than the rest of the wing. Basal line geminate, black, distinct. T.a. line geminate, blackish, distinct, outwardly oblique and quite even; a small outward curve only in the interspaces. T.p. line marked by a geminate black spot on the costa, thence indicated only by the slight contrast between median and subterminal space; outwardly well curved over the reniform, and somewhat incurved below. S.t. line prominent, a narrow, slightly irregular line of yellowish white scales scarcely interrupted save toward costa and inner margin. Claviform faintly marked. Ordinary spots moderate in size, normal in form, concolorous, outlined by a narrow line of pale scales surrounding each. Secondaries and abdomen smoky fuscous. Beneath fuscous, powdery, with a reddish shading, more marked on sceondaries; an outer, interrupted, transverse line and a discal spot on secondaries only. Expands 1.25 inches-31 mm.

Habitat: Sierra Nevada, Cal. (McGlashan).

In structural characters this species is nearest to *mirabilis* in the cupida group; front smooth, palpi short, scarcely forming a snout as in *cupida,* fore tarsi not spinose; thorax with a small anterior and posterior divided crest, abdomen depressed. It is an intermediate form between the cupida, exsertistigma and stellaris groups, with the wing form of the former, the tufting of the second, and the maculation of the third. Its best place is probably next to *mirabilis.*

A single female in good condition is before me.

Type Locality: Sierra Nevada, Calif. (McGlashan).

Number and Sexes of Types: 1 ♀.

Types in: National Museum.

Specimens Examined: 15 middle, 1 Plumas Co., 3 Truckee; 1, compared with type, by Dr. William Barnes, Middle; 1, compared with type, by Dr. McDunnough, marked "Type less red, J. McD.", Camp Baldy; (all) California.

Genitalic Slides: 1, Middle, Calif.

Exsertistigma, observabilis, formalis and *facula* form an extremely close set of allied forms which may be discussed together. All sorts of intermediate forms occur, normally; in any series. It is well to note that Dr. Smith placed true *formalis* as *exsertistigma,* together with *observabilis;* and that his *formalis* is true *facula*. *Facula* is the most distinct with a conspicuous contrasting jet black filling to the cell. When the other forms have a black filled cell the black is not so contrasting against the ground color, due to the general corresponding darkening of the ground. Also the cell frequently has a sordid look, instead of being clear black; due to a mixing of ground-color scales with it. The true *exsertistigma* has all the transverse maculation plain and distinct, with a tendency for the cell to be filled with a sordid black. *Observabilis* is merely a little darker form of the same thing; the filling of the cell often matching the darkened ground color of the primaries. *Formalis* is very close to typical *exsertistigma* but appears more suffused. The cell is seldom filled with anything darker than a deep chocolate brown, although it sometimes contrasts against the ground color. Usually some of the transverse maculation is either lost or almost lost. This applies to all or any of the ordinary lines, giving the form the general appearance of the greatest number of *facula* before the author (except for the black cell of *facula*). It is interesting that typical *facula* more nearly approximates *exsertistigma,* in the transverse maculation. In the intermediate forms specimens occur with or without the black filling to the cell and even with or without the black collar. From the *facula* idea appears to have arisen *niger,* all graduations occur in size, and in the shape of the orbicular. Typical *niger* is smaller, lacks the broad black tipped collar and the orbicular is U shaped. Forms also occur with the black of the collar intermediate.

Meta is a form corresponding to *niger,* but with the orbicular more open than in the typical *niger* and the median area, a red patch, contrasting against the rest of the primary. The black filling to the cell is also absent. It is apparently an aberrant form for nothing matches identically the "cotype" in the Barnes collection. A number of "transitionals" are placed with it, but they are all larger. *Morrisonistigma* is possibly a separate line of development from the *facula* idea parallel to *niger*. Typical specimens are readily distinguished by their darker color, and V-shaped orbicular, with the transverse markings standing out very clear cut. Intermediates occur, but are less common than in the other forms. *Emarginata* appears to have arisen from the *formalis* idea. It is very slightly broader winged than the normal *formalis*. It appears to intergrade with aberrant *formalis* (lacking the broad black collar) on one hand and *inelegans* on the other. It is broader winged than the normal and typical *inelegans,* and appears to have a slightly more flaring orbicular in this way more closely approaching suffused, dark *formalis*. Inelegans appears to grade into it in all details of wing size, shape and maculation. Smith described inele-

gans as having a round orbicular. The plate in Hampson, Vol. IV., Lep. Phal B. M., shows an insect similar in size, shape and maculation to *duanca*, but having the crest of *inelegans*. This was supposedly made from the type of *inelegans* in the National Museum. *Duanca* was then undescribed. Likely at that time there was a mixed series and the artist aided himself with another specimen besides the type of *inelegans*.

Carissima appears to be a lighter and redder form, possibly of *emarginata*. Its maculation is more distinct than either *emarginata* or *inelegans*. Harvey's type is a male. There are six specimens corresponding to it in the Barnes Collection, all females, so unfortunately, no genitalic slide could be made, nor could the male antennae be studied for minute differences. Hence, it is held separate awaiting more material.

LAMPRA EXSERTISTIGMA form *CUPIDISSIMA*, Grt.

1875. Grt, Can. Ent., VII, 101, *Agrotis*.
1878. Grt., Can. Ent., X, 234, *Agrotis*.
1878. Grt., Bull. Geol. Surv., IV, 173, *Agrotis*.
1883. Grt., Proc. Am. Phil. Soc., p. 144, 155, *Agrotis*.
1890. Sm., Bull. U. S. N. M., XXXVIII, 24, *trigona*, *orbis*, and *laetula* in error, *(Rhynchagrotis)*.
1891. Grt., Can. Ent., XXIII, 150, (no genus).
1893. Sm., Bull. U. S. N. M., XLIV, 56, *Rhynchagrotis*.
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis (Lampra)*.
1903. Hamp., Cat. Lep. Phal. B. M., IV, 639, pl. LXXVII, f. 15, *Triphaena*.
1908. Sm, Can. Ent., XL, 287, *(barnesi* in error in part ?*), Rhynchagrotis*.

AGROTIS CUPIDISSIMA, Grote (see ante pp. 214 and 27)

Mendocino, June, Mr. Behrens, No. 4 (red label), also No. 164. The California specimens are light red colored, with powdery geminate lines, and variable in appearance; one is a pale fawn, unicolorous, without marks on primaries save indications of the stigmata and the dotted t.p. line. Again, three specimens have the orbicular somewhat V-shaped, open above. The t.p. line is more regular than in *cupida;* it is accompanied by black dots. The subterminal line is nearer the margin than in either *alternata* or *cupida*, but it is more like *alternata* than it is *cupida* in its being irregular, accompanied with powdery black scales; it is preceded on costa by a blackish shade as in *cupida*. The present species I have formerly considered as *alternata* from the markings, and, on Mr. Morrison's authority as *cupida* from the color, but the reniform I now see is more kidney shaped than in either the Eastern *alternata* or *cupida*. I sent a specimen to Mr. Morrison to show the variability of what I supposed was his *exsertistigma,* and he informed me that the specimen was *cupida*. *Afterwards* he returned me my specimen of *exsertistigma,* recorded above, which I then saw was an entirely different species. I have subsequently adopted the view that the California specimens were *cupida,* and that I was in error in considering them to be *alternata*. I now reject both determinations, and consider that the Californian species is allied to both *alternata* and *cupida* and is a new species from the data given above. The habitus of *cupidissima* and size (39 mm) is rather that of *alternata*. The hind wings are a little paler

at base in *cupidissima,* and the lunule more obvious. *A. cupida* does not as yet appear to occur in California. The provisional identification on page 27 (ante) must be erased and the present substituted. I use the number (56) for a different species.

(Can. Ent., VII, 27, 1875, herewith.)

56. *Agrotis cupida* Grote.

A single specimen, without number, sent by Mr. Behrens, belongs apparently to this species.

Type Locality: Sanzalito, Mendocino, Calif. (Sir George Hampson).

Number and Sexes of Types:

Types in: British Museum (4 ♀).

Specimens Examined: 4, Mission San Jose, Calif.; 1, San Francisco, Calif.; 1, "Washington Territory"; 1, Middle, Calif., marked, *"cupidissima,* but type a little redder. G. F. H."; 1 Solano Co., Calif., marked *"cupidissima var. not laetula.* G. F. H." (G. F. H.=Sir George Hampson).

Genitalic Slides: 1, from first compared with type specimens mentioned above; 1, Mission San Jose, Calif.

LAMPRA EXSERTISTIGMA form *CUPIDISSIMA,* ab. *LAETULA,* Grt.

1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 83, *Agrotis.*
1878. Grt., Can. Ent., X, 234, = *cupidissima, (Agrotis).*
1878. Grt., Bull. Geol. Surv., IV, 173, ? an sp. dist. *cupidissima, (Agrotis).*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1890. Sm, Bul. U. S. N. M., XXXVIII, 24, = *cupidissima, (Rhynchagrotis).*
1891. Grt., Can. Ent., XXIII, 150, (no genus).
1893. Sm., Bull. U. S. N. M., XLIV, 56, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal., B. M., IV, 641, pl. LXXVII, f. 19, *Triphaena.*
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*

DISTRACTA, Sm.

1887. Sm., Proc. U. S. N. M., X, 454, *observabilis* in error, *(Agrotis).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 36, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 56, = *laetula, (Rhynchagrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, = *laetula, (Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 641, = *laetula, (Triphaena).*

AGROTIS LAETULA, n. s.

Allied to *cupidissima.* This species is smaller, and has a line on the collar and the thorax and fore wings of a burnt brown, strewn with ocher scales, which fill the stigmata in one specimen and in the other leave the spots concolorous, while encircling them and filling the geminate lines. Except in color, this form differs very little from *cupidissima* while seeming narrower and shorter winged. All the stigmata shown. Hind wings and under surface as in *cupidissima,* which is a light red species.

Expanse: 34 mm. Nos. 5983 and 180, California, Mr. Hy Edwards.

Type Locality: California (?); "Washington Territory, 2 ♂ types" (Sir George Hampson).

Number and Sexes of Types: ♂ and ♀ (original description) "2 ♂" (Sir George Hampson).

Types in: British Museum.

Specimens Examined: See text.

Genitalic Slides: See text.

RHYNCHAGROTIS DISTRACTA Smith, sp. nov.

observabilis Smith.

1887. Smith, Proc. U. S. Nat. Mus., X, 454.

Clay yellow or grayish, more or less powdered with blackish. Costa slightly paler. S.t. space strongly powdered with black, but not darker than the median spaces. Cell as usual, black or dark filled. Transverse lines geminate, black, complete, course as in the preceding species. S.t. line pale, emphasized by a black costal patch and a slight preceding blackish shade. Secondaries fuscous. Collar concolorous.

Expands: 32-34 mm; 1.28-1.36 inches.

Habitat: Washington, Oregon, California.

Varies in the direction of a more even color, the black powderings less distinct, the cell not black though dusky. The specfes has a pecular sordid appearance, and the dense blacki:h atoms with which it is powdered, add to this appearance. It is not unlike *exertistigma* in color and habitus though evidently distinct by the concoforous collar. This is one of the forms which was marked *observabilis* by Mr. Grote, and which I so referred as above cited.

The harpes of the male have the superior process somewhat lengthened and somewhat clavate, and the inferior angle acute. The clasper is very short and rather thick.

Type Locality: Washington, Oregon, California.

Number and Sexes of Types:

Types in:

Specimens Examined: 1, Washington.

Genitalic Slides: 1, Washington.

This is the most distinct form of all. All specimens before the writer have the orbicular U-shaped, open to the costa. The writer has never seen a specimen with a black-tipped collar; nor with the cell filled in with black between the stigmata; although Dr. Smith speaks of *distracta*, "cell as usual, black or dark filled," but afterward amplifies his description, "the cell not black though dusky."

Cupidissima has a characteristic "pepper and salt" appearance, due to a sprinkling of black scales over the primaries. It may be almost any color or shade. *Laetula* comes nearest to it on one hand and *exsertistigma* via *observabilis* on the other. *Laetula* is similar in all respects, but smaller and stubbier. It is very probably an aberration of *cupidissima*. Dr. Smith sunk his own *distracta* to this form, and there it may remain. The type of *distracta* appears lost, but the author has this note of Dr. McDunnough: "Type *distracta*, Sm., is possibly a specimen in Neum. Coll. labeled by Grote *observabilis*." In Bull. XXXVIII, U. S. N. M., 36, Smith describes *distracta* and adds: "This one is of the forms marked *observabilis* by Mr. Grote, and which I so referred as above cited." (See original description of *distracta*.) The type of *distracta* should be in the Neumogen Collection, either labeled as "Type" or as *observabilis* in Mr. Grote's handwriting. Although there appeared to have been a specimen in the Neumogen Collection labeled *observabilis* by Mr. Grote in accordance with the note of Dr. McDunnough quoted above, this specimen has since disappeared.

The author has a stubby-winged form before him, in the cell of which there is blackish scaling. He cannot differentiate between this form and Mr. Grote's *laetula*. Apparently it is one of a very

old lot, from the Doll Collection, and very possibly the "Washington" locality mentioned by Dr. Smith in his description of *distracta.* It is labeled *observabilis* in Mr. Grote's handwriting, which corresponds with Dr. Smith's statements. We can therefore do one of two things with *distracta*—keep the name for the form of *laetula* with the space between the stigmata filled with blackish granulations, or discard it into the synonomy of *laetula.* As Dr. Smith named it, and then sunk it of *laetula,* the author prefers to do the same.

Laetula seems very rare in collections. The author has seen only the *distracta* form mentioned above. This, fortunately, was a male, and its genitalia were identical in every detail to those of one specimen of *cupidissima.*

The following synonymy is proposed for *cupidissima:*

L. exsertistigma,
form *cupidissima,*
ab. *laetula* = *(distracta)*

LAMPRA EXSERTISTIGMA form *MORRISONISTIGMA,* Grt.

1875. Grt., Can. Ent., VII, 101, ? an sp. dist. *alternata, (exsertistigma),* Grt. nec Morr. ?), *(Agrotis.)*
1875. Grt., Bull. Buff. Soc. Nat. Sci., II, 303, an sp. dist., *(exsertistigma,* Grt. nec Morr. ?), *(Agrotis).*
1876. Grt., Bull. Buff. Soc. Nat. Sci., III, 79, pl. IV, f. 8, *(exsertistigma* or *morrisonistigma), Agrotis.*
1887. Sm., Proc. U. S. N. M., X, 452, *(exsertistigma,* Grt. nec Morr. =*confusa), Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 37, *(exsertistigma,* Grt., nec. Morr. = *confusa), Rhynchagrotis.*
1891. Grt., Can. Ent., XXIII, 151, *Agrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 57, *(exsertistigma,* Grt. nec. Morr. = *confusa), Rhynchagrotis.*
1894. Grt., Can. Ent. XXVI, 84, *Agrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, *exsertistigma,* Grt. nec Morr., *(Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 632, *(exsertistigma,* Grt. nec. Morr. = *confusa), Triphaena.*

BINOMINALIS, Sm.

1887. Sm., Proc. U. S. N. M., X, 451, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 34, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 55, = *costata, (Rhynchagrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, = *costata, (Agrotis) (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 631, = *costata, (Triphaena).*

CRENULATA, Sm.

1887. Sm., Proc. U. S. N. M., X, 451, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 37, *Rhynchagrotis (confusa?).*
1893. Sm., Bull. U. S. N. M., XLIV, 56, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis, (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 630, pl. LXXVI, f. 31, *(Triphaena).*
1908. Sm., Can. Ent., XL, 225, *Rhynchagrotis.*
1917. B. & McD., Check List Lep., p. 48, = *morrisonistigma, (Rhynchagrotis).*

AGROTIS EXSERTISTIGMA, Morr. (fide Auctor)

This species has leathery-brown fore wings with the orbicular open, V-shaped, to the pallid costal margin. Collar pale with a black line above. Space between and before the stigma on cell black. A black basal curved dash. Lines absolutely geminate with pale included shades which are noticeable. Thorax brown; hind wings fuscous with interlined fringes whitish outwardly. The species looks like the cupida group of the genus, but the abdomen is cylindrical, not flattened.

A specimen was returned me by Mr. Morrison as the type of his *exsertistigma*, Bost. Proc., 1874. Subsequently I am informed that the specimen does not agree with the one retained by himself and that Mr. Morrison considers this last specimen (which I have been unable to see since sending it to him at his request originally) as the "true type" of *exsertistigma*. I am of the opinion that the descriptions published by Mr. Morrison in the article here quoted, in the genus Agrotis were too indefinite to be admitted into scientific literature, and that the names there proposed should not be entitled to precedence. I have, however, tried to adopt them all to avoid irritating questions. In this case I have adopted the first determination of the author of *exsertistigma;* if his second one obtains, the present is an undescribed species and hence may be known as *Morrisonistigma*.

This species is No. 1393 of Mr. Edward's collection.

Type Locality: California.

Number and Sexes of Types:

Types in: Henry Edward Collection (1 ♂); Brooklyn Institute Collection (1 ♂).

Specimens Examined: 1, compared with type in the Henry Edwards Collection marked, "Ground color of type redder, J. McD.", from Pullman, Washington; 3, compared with type *crenulata* (Brooklyn) from Calif.; Central Calif.; Truckee, Calif; 1, compared with type *crenulata*, marked "Extract, W. B.", from New Mexico; 1, compared with the male type of *binominalis*, by Dr. McDunnough in the Tepper Collection, from Pullman, Washington; 1, Plumas Co., and 1, Shasta Retreat, Calif.; 1, Hunters, Washington; 1, Pullman, Washington; 10, Stockton, Utah; 2, Vineyard, Utah; 1, Provo, Utah; 4 Deer Creek, Utah; 2, Truckee, Calif.; 1, Wellington, B. C., labeled *confusa*, by Dr. Smith. Also one female marked, "This is exact with so-called female type of *binominalis* from S. Calif. in Coll. Tepper.", in Dr. McDunnough's handwriting, from California, but the specimen is a normal female form of *formalis;* (See text).

Genitalic Slides: 1, California; 1, Pullman, Washington; 1, Wellington, B. C.

A. BINOMINALIS Smith, sp. nov.

Primaries red-brown; costa and collar inferiorly yellowish; collar tipped with black; cell around the ordinary spots black. Transverse lines geminate; t.a. line not crossing costal pale space, else distinct; t.p. line punctiform, barely traceable; s.t. line pale, interrupted, powdery. Stigmata pale-ringed, orbicular invaded by costal space; reniform slightly cinereous; claviform faintly outlined in pale. Abdomen and secondaries smoky fuscous. Side pieces of ♂ short and broad, superiorily prolonged into a cylinderical finger-like process; inferiorly into a short acute spur. The clasper consists of a single curved hook from the superior portion of side piece. Expands 1.5 inches (38 ^{mm}.

Habitat: California, Washington Territory.

This is the *exsertistigma of the Edwards* collection, and like one specimen so labeled in Mr. Tepper's collection. The typical *exsertistigma* is, as Mr. Morrison described it, much like *alternata* in color and appearance.

Type Locality: California, Washington Territory.

Number and Sexes of Types: ♀ ♂.

Types in: Tepper Collection, ♂ "Type" = Lectotype, ♀ "Type".

Specimens Examined: See data under *morrisonistigma,* and text discussion.

A. CRENULATA Smith, sp. nov.

Primaries deep dark brown; basal and s.t. space slightly paler, powdered with gray; costal space paler red brown; ordinary spots powdered with gray; claviform outlined with pale yellow scales. Transverse lines distinct; t.a. lines geminate, included space pale; t.p. line crenulate, course as in the preceding species; (#); s.t. line distinct, pale yellowish, punctiform. Basal black dash distinct; cell black. Side pieces of ♂ as in the preceding species; but the projections at upper and inferior angles are longer, and there is an additional curved slender projection from upper margin. The clasper is lacking, but is replaced by a quadrate corneous plate. The additional projection of side pieces probably serves the same purpose as the clasper of the preceding species. Expands 1.4 inches (36 ^{mm}).

Habitat: California.

This is the *facula* of Mr. Neumoegen's collection, so named by Mr. Grote. The differences are so obvious, that there seems scarcely an excuse for the error. The difference in the ♂ genetalis is very decided also. A single ♂ specimen only in Mr. Neumoegen's collection.

(#); *A. binominalis* Smith, sp. nov. (Benj.).

TYPE LOCALITY: California.

NUMBER AND SEXES OF TYPES: ♂ ♀.

TYPES IN: 1 ♂, Neumoegen Collection; 1 ♀, National Museum.

SPECIMENS EXAMINED: See data under *morrisonistigma,* and text discussion.

Dr. Smith does not name the number of his types of *binominalis.* A male and female are in the Tepper Collection marked "Type." Smith states in Bull. 44 U. S. N. M. that the type is in the Tepper Collection. Compared specimens show the female type to be one of the normal female forms of *formalis,* a bred specimen of female *formalis* matching it very closely. For this reason, Dr. Smith's male type in the Tepper Collection is hereby chosen the lectotype for the name *binominalis.*. Compared specimens show this to be the same as *morrisonistigma.*

Dr. Smith does not recognize the name *morrisonistigma* in any of his writings and in Bull 44 U. S. N. M. sinks his own *binominalis* to *costata* along with *exsertistigma,* Grt. nec Morr. in part. In other words, Smith plainly made his name *binominalis* in order to straighten out the *exsertistigma* tangle, and to give a name to *exsertistigma,* Grt. nec. Morr. This was unnecessary for the reason that *exsertistigma,* Grt. nec Morr. already had a valid name; viz, *morrisonistigma.*. He was wrong in believing Grote's *exsertistigma (morrisonistigma)* with his own *binominalis* to be synonyms of *costata.* The type of *costata* is without a head, in the British Museum, hence Hampson's error in thinking it belonged to this group. Specimens of a Euxoa sent to him by Messrs. Barnes and McDunnough proved to be *costata.* Hence *costata* was removed from *Rhynchagrotis costata* to *Euxoa* costata in the Check List, B. & McD., 1917. This leaves *binominalis* = exsertistigma, Grt. nec Morr.

Grote preferred to consider that Morrison sent him the type of *exsertistigma,* as stated in 1895, Abh. Nat. Ver., Bremen, and that Morrison's type in the Graef Collection was a subsequent, worthless

one. This seems highly probable, but there is no way of proving it. Also, Mr. Grote recognized that such might not be the case when he said in Bull. Buff. Soc. Nat. Sci., III, 79: "if his (Morrison's) second one obtains the present is an undescribed species and hence may be known as *Morrisonistigma*." In short, both names *morrisonistigma*, Grt. and *exsertistigma*, Morr. must stand; a fact which Smith did not recognize. Hence Smith's *binominalis* is a straight synonym of *morrisonistigma*, and described partially from the identical type lot of that species.

By careful comparisons of both Dr. Barnes and Dr. McDunnough, *crenulata* has been proven synonymous with *morrisonistigma*, and so listed in the Check List Lep., B. & McD., 1917. These compared specimens are before the author and there seems no possible room for doubt.

GROUP ANCHOCELIOIDES

Distinguished by possessing a strong chitenous clasper to the male genitalia, an untufted thorax; antennae with minute cilia and larger setae from each joint; bodies of females very broad and blunt at the tip, usually broader than at the base. All forms with the wings relatively narrow except *belfragei*, which closely resembles *alternata* in superficial appearance. *Velata*, Wlk., is unknown to the author. He has seen only a single specimen resembling *cupida* from the West Coast. Unfortunately it was a female, so there was no chance to check the genitalia with that of *cupida*. Temporarily it seems best to leave this species in the synonomy of *cupida*; as per the writings of Butler, Grote, Smith, and Hampson: bearing in mind the possibility of there being a valid species of the Anchocelioides Group in Vancouver.

Superficial Key to the Anchocelioides Group

I.—Size large (40 mm) (Texas only known locality)........*belfragei*

II.—Size moderate to small (under 36 mm).

A.—Primaries dull, powdery; maculation distinct; (resembling *alternata*) ....*anchocelioides*

B.—Primaries with a satiny luster, at least part of the maculation normally suffused by the ground color,

a.—Ground color of the primaries variable, any color except deep purple-brown..*cupida*

b.—Ground color of the primaries deep purple-brown; form ....*brunneipennis*

Genitalic Key to the Anchocelioides Group

I.—Base of the ampulla of the clasper arising free of the sacculus, its base partially above the junction of the arm and body of the valve; plate of the penis with minute spines ....*anchocelioides*

II.—Base of the ampulla of the clasper covered partially by the sacculus,arising well below the junction of the arm and body of the valve (see figure),

A.—Plate of the penis with flatened "teeth"................*belfragei*

B.—Plate of the penis with smaller and more numerous well developed "teeth"...*cupida*

form.......................................*brunneipennis*

N. B.—A.—and B.—well within the possible range of variation of one species, but scuperficially quite different.

LAMPRA CUPIDA, Grt.

1864. Grt. Proc. Ent. Soc. Phila., III, 525, pl. 5, f. 7, *Noctua.*
1869. Grt., Trans.. Am. Ent. Soc., II, 309, *Agrotis.*
1874. Grt., Can. Ent., VI, 16, *Cerastis.*
1878. Grt., Can. Ent., X, 234, *Agrotis.*
1878. Lintn., Ent. Cont., IV, 124, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., p. 144, *Agrotis.*
1889. Butl., Trans. Ent. Soc. Lond., p. 383, = *phyllophora, (Amathes).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 19, *Rhynchagrotis.*
1891. Grt., Can. Ent., XXIII, 150, (no genus).
1893. Sm., Bull. U. S. N. M., XLIV, 52, = *anchocelioides, (Rhynchagrotis).*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 638, = ab. 2. of *anchocelioides;* pl. LXXVII, f. 13, *cupida* plated in error for *anchocelioides. (Triphaena).*
1903. Holl., Moth Book, p. 178, pl. XXI, f. 19, as *anchocelioides* in error ?. *(Rhynchagrotis).*
1908. Sm., Can. Ent. XL, 286, = *anchocelioides, (Rhynchagrotis).*

VELATA, Wlk.

1865. Wlk., C. B. Mus., Het., XXXII, 710, *Graphiphora.*
1889. Butl., Trans. Ent. Soc. Lond., p. 383 = *cupida* = *phyllophora, (Amathes).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 19, = *cupida, (Rhynchagrotis).*
1893. Sm., Bull. U. S. N. M., XLIV, 52, = *anchocelioides, (Rhynchagrotis.)*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, = *cupida, (Agrotis), (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 638, = *anchocelioides, (Triphaena).*

NOCTUA CUPIDA, nov. sp. (Plate 5, fig. 7, ♂)

Anterior wings uniform reddish ferruginous, very sparsely sprinkled with blackish scales, darker shaded in the sub-terminal space, ordinary lines dark, indistinct. Basal line very faint, geminate; transverse anterior geminate, faint, dentate below the costa, thence regularly undulate to internal margin; ordinary spots distinct, annulated with a paler shade, the orbicular very slightly oblique, concolorous with the rest of the wing, reniform moderate, with an evenly blackish center, of the normal shape. Transverse posterior line geminate, very faint, surmounted by two costal spots, nearly straight, but slightly arcuated at the disc. Sub-terminal space of an even dull brownish color; sub-terminal line broadly marked with blackish at costa, forming slightly darker points on the veins. Terminal space concolorous with median and basal spaces; fringes blackish. Posterior wings uniformly blackish cinereous, hardly darker shaded along external margin, silky, immaculate; fringes paler, with a central darker line. Under surface

of anterior wings reddish along the costa, apex and fringes, rest of the wing blackish cinereous, with a median blackish transverse line indistinct except at costa; under surface of posterior pair paler than the upper surface, shaded with reddish along the costa, irrorate with black scales and with a faint blackish transverse band and discal spot. Head, prothorax and thorax reddish ferruginous, concolorous with anterior wings, palpi darker laterally. Abdomen flattened, pale cinereous, reddish along the sides and at the anus. Exp. ♂ 1.30 inch.

Habitat: Middle States. (Coll. Ent. Soc. Phil.)

This would appear to resemble Graphiphora expansa and G. jucunda of Mr. Walker by the description of these latter in the British Museum Lists, but I cannot reconcile the diagnosis with the present species.

Type Locality: Middle States.

Number and Sexes of Types:

Types in: Holotype ♂, Collection Amer. Ent. Soc., Phila.; "Type" ♀, British Museum.

Specimens Examined: about 200; from, Browns Mills and Pitman, N. J.; New Brighton, Pa.; Concord, Mass.; N. Y.; Yaphank, L. I., N. Y.; Lafayette, Ind.; Chicago, Ill.; Mich.; S. Dak.; Decatur, Ill.; Dublin Shore, Nova Scotia; Cartwright, Manitoba. One specimen, compared with the type in the Amer. Ent. Soc., by Dr. McDunnough.

Genitalic Slides: 20, Browns Mills, N. J.; 1, Decatur, Ill.; 1, Dublin Shore, N. S. (Total 22).

GRAPHIPHORA VELATA

Mas. Ferrugineo-rufa; palpi porrecti, articulo 3o brevissimo; abdomen obscure cinereum; alae anticae breviusculae, latiusculae, nigro conspersae, lineis tribus nigricantibus vix undulatis, orbiculari et reniformi magnis nigricantibus rufescente marginatis; posticae fuscae, fimbria albida fusco interlineata.

Male. Ferruginous-red, dark cinereous beneath. Palpi porrect, short, stout, pilose; third joint very short. Antennae smooth. Abdomen dark cinereous, quadrate at the tip, extending hardly beyond the hind wings. Legs rather slender, slightly pilose. Fore wings rather short and broad, minutely black-speckled; orbicular and reniform marks large, blackish, reddish-bordered, of the usual form; three slight blackish hardly undulating lines; two on the inner side of the orbicular mark and one near the exterior border; marginal points black. Hind wings brown; fringe whitish, interlined with brown. Length of the body 7 lines; of the wings 16 lines.

It may be distinguished from G. ilapsa by the distinct orbicular mark and by the antemedial line, which is much nearer to that mark.

a. Vancouver's Island. Presented by Lieut.-Col. Hawkins.

Type Locatitys Vancouver Island.

Number and Sexes of Types: 1 ♀.

Types in: British Museum.

Specimens Examined: See Text.

LAMPRA CUPIDA form *BRUNNEIPENNIS*, Grt.

1875. Grt., Can. Ent., VII, 187, *Agrotis*.
1878. Grt., Can. Ent., X, 234, *cupida* var. ?, (*Agrotis*).
1883. Grt., Proc. Am. Phil. Sos., p. 144, *cupida* var. ?, (*Agrotis*).
1890. Sm., Bull. U.S.N.M., XXXVIII, 19, *cupida* var., (*Rhynchagrotis*)
1891. Grt., Can. Ent, XXIII, 150, (no genus).
1893. Sm., Bull. U.S.N.M., XLIV, 52, *anchocelioides* var., (*Rhynchagrotis*).
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, *cupida* var., (*Agrotis*) (*Lampra*).
1903. Hamp., Cat. Lep. Phal. B. M., IV, 638, = ab. 1. of *anchocelioides*, (*Triphaena*).
1908. Sm., Can. Ent., XL, 286, *Rhynchagrotis*.

AGROTIS BRUNNEIPENNIS, n. s.

Allied to *cupida*, but smaller. Fore tibiae unarmed. Thorax and fore wings of a glossy chestnut brown, somewhat reddish. None of the usual markings are noticeable. The subterminal space is stained with blackish. Following the s.t. line is a series of faint pale interspaceal fleckings. Ordinary lines indicated on costal region. Hind wings blackish fuscous. Abdomen beneath stained with reddish brown as is the costal region of primaries; else the blackish wings beneath show only a common black transverse line, which fades out towards the internal margins. Palpi black at the sides. Head brown above.

Expanse 30 m.m. Mass., Mr. Thaxter, No. 2,303.

Type Locality: Massachusetts.

Number and Sexes of Types:

Types in: British Museum, 1 ♂.

Specimens Examined: about 40 showing all gradations to *cupida;* from, Concord, Mass.; Flatbush, N. Y. City, N. Y.; N. Y.; Lititz and Bethlehem, Pa.; Browns Mills, N. J.

Genitalic Slides: 1, Concord, Mass.; 1, Browns Mills, N. J.

This is a very common and variable species; seemingly in a very unstable evolutionary state. Scarcely any two specimens are identical in appearance or color. Its one distinguishing superficial character is a bright glossy sheen to the wings. Its wing shape, also, is peculiar; the primaries being narrow, elongate, and with more of an incurve to the inner margin, than is possessed by other members of the genus. It can scarcely be confused with any other species in the genus due to this peculiar wing shape and glossy appearance.

Cupida and form *brunneipennis* intergrade as might well be expected, and there are all kinds and styles of intermediates; from light yellowish thru reds to deep purple and almost black.

The author thinks it best to restrict the name *brunneipennis,* as a form, to the deep purple-brown, mentioned by Hampson. This form appears to be commonest in Massachusetts, altho the author has specimens of this color, but larger than typical, in his collection from Browns Mills, N. J.

LAMPRA BELFRAGEI, Sm.

1878. Grt., Can. Ent., X, 234, *cupida* form, (*Agrotis*).

1890. Sm., Bull. U. S. N. M., XXXVIII, 19, *Rhynchagrotis.*

1891. Grt., Can. Ent., XXIII, 150, (no genus).

1893. Sm., Bull. U. S. N. M., XLIV, 53, *Rhynchagrotis.*

1895. Grt., Abh. Nat. Ver., Bremen, XIV, 18, *Agrotis* (*Lampra*).

1903. Hamp., Cat. Lep. Phal. B. M., IV, 640, pl LXXVII, f. 16, (size, too small), *Triphaena.*

1908. Sm., Can. Ent., XL, 286, *Rhynchagrotis.*

RHYNCHAGROTIS CUPIDA, Grt.

1864. Grt., Proc. Ent. Soc. Phil., III, 525, pl. 5f. 7, Noctua.
1869. Grt., Trans. Am. Ent. Soc., II, 309, Agrotis.
1874. Grt., Can. Ent., VI, 16, Cerastis.
1878. Grt., Can. Ent., X, 234, Agrotis.
1878. Lintner, Ent. Cont., IV, 124, Agrotis.
1889. Butler, Trans. Ent. Soc., Lond., 1889, 383, Amathes, velata Wlk.
1865. Wlk., C. B. Mus., Lep. Het Suppl., 3,710, Graphiphora.
1889. Butler, Trans. Ent. Soc., Lond., 1889, 383, pr syn. Var bruunei-pennis Grt.
1875. Grt., Can., Ent. VII, 187, Agrotis.
1878. Grt., Can. Ent. X, 234, an var. pr. ?
1883. Grt., Proc., Am. Phil. Soc., XXI, 155, Agrotis.

Varies in color of thorax and primaries from drab or clay yellow to dark red brown, more or less powdery. The more usual form is a brick or dull red, abdomen somewhat more grayish; secondaries fuscous to blackish, sides of palpi also black. The maculation is often more or less indistinct, but when fully present is as follows: All the lines geminate. Basal line, black, curved t.a. line outwardly oblique, blackish, waved, included space paler; a distinct black spot on costa at inception of inner line, outer line punctiform; the line makes a slight outward curve over discal sell. S.t. line initiated by a large distinct black costal patch, then sinuate, rather as a darker shade emphasized by black venular points, followed by a narrow pale shade to hind margin. S.t. space sometimes as a whole darker than the rest of the wing. Ordinary spots distinct, annulate with a paler shade, orbicular very slightly oblique sometimes concolorous, more usually darker; reniform moderate; with an evenly blackish center, of the normal shape. Beneath, primaries reddish along the costa, otherwise blackish gray, with a more or less evident outer line; secondaries paler than above, powdered with reddish along costa, irrorate with black scales; a faint outer line and evident discal spot.

Expands, 31-37^{mm}; 1.25-1.50 inches.

Habitat: Canada to Virginia, west to Pennsylvania; Texas.

From this typical form the variations will run to an almost complete obsolescence of maculation, and again to a darker form, the maculation black and strongly relieved. A permanent feature, which seems the specific character, is the costal spot preceding the s.t. line, and which seems to survive all sorts of modifications. The genital structure of the male is peculiar, as I have already stated, and as shown at Pl. II, f. 3. Mr. Grote has had some of the variations of this species, and he says (Can. Ent. X, 234): "What may be taken as the typical form, or that which is best marked, expands 33-35 ^{mm}. The wings are of a brick brown, with the stigmata filled with black; a black mark on costa at inception of s.t. line; the s.t. space a little darker than the rest of the wing; the lines well defined. A larger form from Texas expands 40 ^{mm}. It has been reared from the larva by Belfrage (No. 674). It is more red, more unicolorous, the markings less obtrusive. A specimen taken by Dr. Bailey is the size of the typical form, but has the subbasal and subterminal spaces entirely filled in with black. Then come three specimens in which the fore wings seem a little narrower, and the expanse smaller. One is bright orange red, all the markings obsolete. Another is more of the typical shade, but both the spots are ringed with bright yellow. The third I have decided as distinct under the name of *brunneipennis.*"

Mr. Grote did not have all the variations, apparently, and was in error in considering the Texan specimens as referable here. It constitutes a very distinct species, nearer to *alternata,* and as such I have separated it in the collection of the U. S. National Museum, which contains several of the Belfrage specimens. It may be called *belfragei,* and the above comparative features will easily separate it. I believe it the only one of this group in Texas.

The type of *brunneipennis* is an extreme form, and Mr. Grote's description may therefore be reproduced:

"Allied to *cupida* but smaller; fore-tibiae unarmed; thorax and fore-wings of a glossy chestnut brown, somewhat reddish; none of the usual markings are noticeable. The sub-terminal space is stained with blackish. Following the s.t. line is a series of faint, pale, interspaceal fleckings; ordinary lines indicated on costal region. Hind wings blackish fuscous; abdomen beneath stained with reddish brown, as is the costal region of primaries, else the blackish wings beneath show only a common black transverse line, which fades out toward the internal margins."

Lintner, in the Ent. Cont., IV, 124, rather doubts the identity of the forms referred by Mr. Grote to this species, and describes the larval habits of the species without describing the larva itself. According to him it is sometimes quite injurious to grape, feeding on the buds.

The species is the most common eastern representative of its group.

Mr. Butler's reference of *Graphiphora velata* Wlk. as a synonym of this species, is accepted as an easy way of getting rid of Walker's name, and because the reference is probably correct.

Type Locality: Texas (Belfrage).

Number and Sexes of Types:

Types in: National Museum, 1 ♂, 3 ♀.

Specimens Examined: 2 ♂, 2 ♀, Texas, (Presumably all Topotypes from the Type Lot) (1 ♀ compared with type by Dr. William Barnes).

Genitalic Slides: 1, Texas, (see above).

Thru some misapprehension Dr. Smith removed the form mentioned by Mr. Grote from its relatives in the "Cupida Group" and placed it in the "Alternata Group." In reality, it appears to be mererly a form of the true *anchocelioides* which has produced a genitalia identical with that of *cupida*. It is not unlikely that Grote looked at its genitalia and that Smith did not, for in size and maculation it is almost identical with smooth-looking *alternata*, except for the course of the s.t. line, but the orbicular is smaller and rounder than is typical in that species. It also has a little more of a silky luster to its wings; in that way resembling *cupida*. Until complete life history notes are obtained for both *belfragei* and *anchocelioides* it seems best to keep the two forms as separate species. Like *anchocelioides, belfragei* is rare in collections, and the author knows of no specimens outside of the original type lot from Mr. Belfrage.

LAMPRA ANCHOCELIOIDES, Gn.

1852. Gn., Sp. Gen., Noct., I, 384, *Cerastis*.
1857. Wlk., C. B. Mus., Het., X, 452, *Cerastis*.
1874. Grt., Bull. Buff. Soc. Nat. Sci., II, 26, *Glaea*.
1893. Sm., Bull. U. S. N. M., XLIV, 52, = *cupida*, (*Rhynchagrotis*).
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, *anchocelioides*, Sm., nec. Gn. (in error).
1903. Hamp., Cat. Lep. Phal. B. M., IV, 638, = *velata, cupida* plated in error. (*Triphaena*).
1903. Holl., Moth Book, p. 178, pl. XXI, f. 19, *Rhynchagrotis*, probably *cupida* in error.
1908. Sm., Can. Ent., XL, 286, *Rhynchagrotis*, probably *cupida* in error.

639. CERASTIS ANCHOCELIOIDES, Gn.

38 mm. Ailes super. oblongues, coupees carrement au bord terminal, d'un gris-testace teinte de rougeatre, surtout a la cote et a la frange, cette derniere divisee par un filet de cette couleur. Espace subterminal formant une bande plus foncee, tandis que l'espace terminal est au contraire plus clair, sans ligne subterminale autre que l'opposition de ces deux nuances. Lignes medianes plus foncees, largement geminees, interrompues et comme ponctuees. Toutes ces lignes presque paralleles. Taches medianes visibles, un peu plus foncees et cerclees de clair. Ailes infer, noiratres, a frange plus claire et egalement divisee par un filet fonce. Abdomen de la ♀ epais, quoique deprime. Palpes unicolores.

Amerique Septentrionale. Coll. Bdv. et Dbday. Deux ♀.

Type Locality: North America.

Number and Sexes of Types: 2 ♀.

Types in: British Museum.

Specimens Examined: Total, 12; 7 ♂, 5 ♀; from, Columbus, Ohio; Wisc.; Cartwright, Manitoba; Meach Lake, Quebec; also (Winnipeg, and Westbourne, Manitoba, 1 ♂ each, Collection Mr. Wallis).

Genitalic Slides: 1, Columbus, Ohio.

This is apparently a valid species allied to *cupida.* Specimens of *cupida* approach it in color and maculation but all eastern *cupida* forms have a glossy, satiny, shine to the wings, almost lacking in this species. While the wings are narrow they are squarer shaped than in *cupida. Anchocelioides* is more likely to be mistaken for *alternata* than *cupida. Alternata* and *anchocelioides* were mixed in the Barnes Collection, whereas *cupida* was very nicely separated. From *alternata,* it can be told by its strong chitenous ampulla to the clasper instead of a membraneous one. In general the s.t. and t.p. lines are closer together than in *alternata,*—causing a narrower-banded appearance. In this respect it resembles *cupida.* There is a tendency for the orbicular and the reniform to be smaller than in *alternata,* and for the orbicular to be rounder; but this is not a very safe character to use. The s.t. line appears straighter than in *alternata;* and while both have two "teeth" to the line, those of *anchocelioides* seem rather like minor projections on a general flat outward projection of the line; whereas in *alternata* the second tooth forms a W-mark. The terminal area of the primaries of the *anchocelioides* before the author is not concolorous with the ground; and in this it differs from the average *cupida,* but resembles *alternata.*

In short it appears to be a valid species intermediate between *cupida* and *alternata;* in size, narrowness of primaries, and genitalia resembling *cupida;* in general maculation and squareness of wings resembling *alternata.*

Sir George Hampson had it confused with *cupida* (Cat. Lep. Phal., B. M., IV) but the author has a specimen before him, compared with the type of *anchocelioides* in the British Museum, by Sir George Hampson, which very nicely clears the situation. Once separated in collections it cannot possible be confused, especially with *cupida.* Hampson's figure of *anchocelioides* is apparently from one of the *cupida* of the Grote Collection.

Anchocelioides appears to be rare in collections, and is probably confused with *alternata,* wherever it is found.

GROUP BRUNNEICOLLIS

This group includes two species. It is distinguished by having a dark-brown head and collar, concolorous; contrasting with the ground color of the wings; and an uncrested thorax. The group seems to be in a very stable evolutionary state, for while the colors of specimens may vary considerably within the species, the genitalia are remarkably constant.

SUPERFICIAL KEY TO THE BRUNNEICOLLIS GROUP

I.—Lines double (on primaries)..*brunneicollis*
II.—Lines single ....*rufipectus*

GENITALIC KEY TO THE BRUNNEICOLLIS GROUP

I.—Uncus not ladle-shaped; juxta a plate......................*brunnecollis*
II.—Uncus ladle-shaped; juxta with (very) large spine....*rufipectus*

LAMPRA BRUNNEICOLLIS, Grt.

1864. Grt., Proc. Ent. Soc. Phila., III, 524, pl. 5, f. 5 ♂, *Noctua.*
1869. Grt., Trans. Am. Ent. Soc., II, 309, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., XXI, 144, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 15, 18, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 51, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 58, *Agrotis* (*Lampra*).
1903. Hamp., Cat. Lep. Phal. B. M., IV, 629, pl. LXXVI, f. 30, *Triphaena.*
1908. Sm., Can. Ent., XL, 223, *Rhynchagrotis.*

NOCTUA BRUNNEICOLLIS, nov. sp. (Plate 5, Fig. 5. ♂)

Anterior wings narrow, cincereous, with a uniform, more or less determined, reddish shade; ordinary lines dark, distinct but interrupted. Basal half-line blackish, distinct, straight; transverse anterior blackish, geminate, nearly straight, forming three even curves. Ordinary spots large, distinct, concolorous with the rest of the wing, annùlated with a darker line, the reniform broad, but slightly excavated externally; transverse posterior line sub-obsolete, forming black dots on the veins, between each of which the line forms an inward undulation; sub-terminal line diffuse, blackish, broadly marked at the costa, immediately below which it is interrupted, thence with a single outward inclination it is continued distinct to internal margin; fringes long, darker than the rest of the wing. Posterior wings broad, very pale grayish testaceous, immaculate, concolorous, very slightly darker shaded along external margin. Under surface of anterior wings reddish along the costa, rest of the wing blackish cinereous, paler along terminal margin; under surface of posterior wings similar to upper surface except along the costa, where they are powdered with reddish and grayish scales; both pair crossed by a very indistinct blackish line. Palpi and head reddish brown, latter darker on the vertex; collar very dark reddish brown, distinctly contrasted with the thorax and tegulae which share the coloration of anterior wings. Abdomen somewhat flattened, dark grayish testaceous above, beneath, with anal tuft, of a more reddish hue. Legs dark grayish, becoming brown on the tibiae and tarsi, latter marked with testaceous at base. ♂. ♀. Exp. 1.40 to 1.50 inch.

Habitat: Middle States. (Coll. Ent. Soc. Phil.)

Allied to *Nocuta clandestina,* Harris (*Graphiphora lubricans,* Walk.) and belonging to the genus *Graphiphora* of some Authors. It is, however, to this and allied forms that Linnaeus' generic term *Noctua* is at present restricted and should be applied. My correspondence with Mr. Walker has elicited the information that the present species has not been hitherto described.

TYPE LOCALITY: Middle States.
NUMBER AND SEXES OF TYPES:
TYPES IN: Am. Ent. Soc., Phila.
SPECIMENS EXAMINED: Total 22; from, Newton Highlands and Concord, Mass.; Jefferson, N. H.; Brand Lake, N. Y.; Richmond Hill, Yaphank and Flushing, L. I. (N. Y.); Dutchess Co., N. Y.; New Brighton, Pa.; Oconee, Ill.; Colo. (Bruce). One specimen, compared with type, from New Brighton, Pa.
GENITALIC SLIDES: 1, Concord, Mass.; 1, Yaphank, L. I., N. Y.

LAMPRA RUFIPECTUS, Morr.

1874. Morr., Proc. Bost. Soc. Nat. Hist., XVII, 165, *Agrotis.*
1876. Grt., Ann. Lyc. Nat. Hist., N. Y., XI, 304, *Agrotis.*
1883. Grt., Proc. Am. Phil. Soc., XXI, 144, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 15, 17, *Rhynchagrotis.*
1893. Sm., Bull. U. S. N. M., XLIV, 51, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 58, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 629, pl. LXXVI, f. 29, *Triphaena.*
1903. Holl., Moth Book, 178, pl. XXI, f. 22, *Rhynchagrotis.*
1908. Sm., Can. Ent., XL, 222, *Rhynchagrotis.*

AGROTIS RUFIPECTUS, Nov. sp.

Expanse: 39 mm.

Collar dark brown, disconcolorous. Breast red. Anterior wings and thorax light violaceous gray. The markings indistinct, the lines simple, the spots annulate, concolorous. A black dot in the basal space. Interior line oblique, undulate. The subterminal line faint, preceded by a more or less distinct, blackish, duffused shade. Beneath, the anterior wings are tinged on the costa with carneous.

Hab. New York. (T. L. Mead.) Kindly sent me by Mr. A. R. Grote, for determination.

TYPE LOCALITY: New York.
NUMBER AND SEXES OF TYPES:
TYPES IN:
SPECIMENS EXAMINED: Total 85; from, Lewis Co., N. Y., (Hill); Hymers, Ont.; Cartwright, Man; Calgary, Alberta; Kaslo, B. C.; Arrowhead Lake, B. C.; Wallace, Idaho; Yellowstone Park, Wyo.; Colo., (Bruce); Provo, Vineyard and Deer Creek, Utah; Duncans, Vanc. Is.; Hot Springs, (Green River) Wash.; Truckee and Yosemite, Calif.; White Mts., Ariz.; Richmond Hill, L. I., N. Y.
GENITALIC SLIDES: 1, Provo, Utah; 1, Wallace, Idaho; 1, White Mts., Ariz.; 1, Richmond Hill, L. I., N. Y.

SPECIES UNKNOWN TO THE AUTHOR

LAMPRA HERO, Morr.

1876. Morr., Proc. Bost. Soc. Nat. Hist. XVIII, 238, *Agrotis.*
1882. Grt., New List, 25, *Agrotis.*
1890. Sm., Bull. U. S. N. M., XXXVIII, 228, *Agrotis,* (species not placed).
1893. Sm., Bull. U. S. N. M., XLIV, 67, *Agrotis,* (unknown).
1895. Grt., Abh. Nat. Ver., Bremen, XIV, *Agrotis,* "Mattachusetts".
1903. Hamp., Cat. Lep. Phal. B. M., IV, 630, *Triphaena,* (unknown).

AGROTIS HERO nov. sp.

Related to *collaris* and *baclinodis,* but separated from them by the unarmed fore tibiae.

Collar black and disconcolorous above. Thorax concolorous with the anterior wings. Anterior wings crossed by two even, simple, dark brown lines, the first preceded, the second followed by a pale accompanying line;

ordinary spots not well defined ,shaped as in *collaris,* the orbicular preceded by a black spot; the median shade distinct, passing between the spots; subterminal space darker brown, subterminal line indefinite. Posterior wings uniform dark brownish gray, discal dots present. Beneath brownish gray, with discal dots and a common diffuse median line. Expanse, 32 mm.

Hab.: Beverly, Mass. Mr. Edward Burgess.

TYPE LOCALITY: Beverly, Mass.

NUMBER AND SEXES OF TYPES:

TYPES IN:

SPECIMENS EXAMINED: None.

N. B. There is no known insect that this description will fit in all details. Morrison gives it as an "Agrotis" with unspined fore tibiae, with brown wings and "black" collar, thereby practically restricting our choice of known insects to *L. rufipectus* or *brunneicollis.*

CRYPTOCALA, Genus nov.

Rhynchagrotis, Hampson (Smith in part), Cat. Lep. Phal. B. M., IV, 648, 1903. Cites *gilvipennis* as type.

Type, C. GILVIPENNIS

Proboscis fully developed; palpi upturned, the second joint moderately scaled in front, the third scaled; frons smooth; eyes large, rounded; antennae of male ciliated, with longer setae from the segments; head and thorax clothed with hair and scales, the latter without crests; fore tibiae unspined, mid and hind tibiae strongly spined. Fore wing rather narrow, the apex rectangular; veins 3 and 5 from near angle of cell; 6 from upper angle; 9 from 10 anastomosing with 8 to form the aerole; 11 from cell. Hind wings with veins 3, 4 from angle of cell; 5 obsolescent from near middle of discocellulars; 6, 7 from upper angle. (Hind wings always orange with a broad terminal black band.)

CRYPTOCALA GILVIPENNIS, Grt.

1874. Grt., 6th Rept. Peab. Ac. Sci., App., 24, *Agrotis.*
1874. Grt., Can. Ent., VI, 71, *Agrotis.*
1875. Grt., Bull. Buff. Soc. Nat. Sci., II, 301, *Agrotis.*
1875. Morr., Proc. Bost. Soc. N. H., XVIII, 117 = *chardinyi, (Agrotis).*
1876. Grt., Stett. Ent. Zeit., XXXVII, 135 = *chardinyi, (Agrotis).*
1883. Grt., Pros. Am. Phil. Soc., p. 156, = chardinyi ?, *(Agrotis).*
1890. Sm., Bull. U. S. N. M., XXXVIII, 14 = *chardinyi, (Rhynchagrotis).*
1893. Sm., Bull. U. S. N. M., XLIV, 51, *Rhynchagrotis.*
1895. Grt., Abh. Nat. Ver., Bremen, XIV, 17, *Agrotis (Lampra).*
1903. Hamp., Cat. Lep. Phal. B. M., IV, 649, pl. LXXVII, f. 23, *Rhynchagrotis.*
1903. Holl., Moth Book, p. 178, pl. XXI, f. 18, *Rhynchagrotis.*
1908. Sm., Can. Ent., XL, 222, *Rhynchagrotis.*

AGROTIS GILVIPENNIS, Grote. ♂. ♀.

Size moderate. Thorax hairy. Fore tibiae unarmed. Male antennae pubescent and with very short pectinations. Fore wings varying in tint from reddish to dusky ochre brown with the transverse lines blackish, even, tolerably distinct; the t.p. line with a rounded outward extension opposite the cell and a slight outward tooth on vein 1. Ordinary spots sometimes

indistinctly limited. Orvicular very oblique, attaining or fusing with the reniform inferiorly, pale, with indistinct darker interior shades. Reniform upright, moderate, with darker center and pale ochrey ringed. The median space is shaded with blackish posteriorly. Substerminal line distinct and continued, preceded by a dark costal shade relieving two costal pale dots. Terminal line even; fringes dark. Hind wings yellow with yellow fringes and a broad black margin, which intrudes more or less on the central yellow field. Beneath the hind wings are yellow with narrower black hind border and faint discal point; costal region dusky. Fore wings with the center blackish, costal and terminal regions brownish, varying in tone with the upper surface. The body colors vary in tone with the fore wings and the black margins of the hind wings vary in width, sometimes encroaching strongly on the yellow discal field. Expanse 30-34 ^{mm}.

Five specimens have been examined which were collected by Mr. Couper on the Island of Anticosti. The only described North American species with yellow secondaries, and one which would have been referred to "Triphaena" before the structure of these moths was studies. Professor Zeller has kindly compared the species for me with the Siberian A. Chardinyi, to which it is allied, but from which the Professor distinguishes it specifically.

Type Locality: Anticosti Island.

Number and Sexes of Types: ("5 specimens from Mr. Couper").

Types in: 1 ♂, 1 ♀, "Types," British Museum; 1 ♂, "Type," in Morrison's handwriting, without type number, National Museum.

Specimens Examined: Total, 37; from, Calgary, Alberta; Arrowhead Lake, B. C.; Banff, Alta.; Cartwright, Manitoba; Hymers, Ontario; Digby, Nova Scotia; Ft. Calgary, N. W. Terr.; Maine; Jefferson, N. H.; Franconia, N .H.; Peru, N. Y. (Husavick, Man. and Peachland, B. C., Mr. Wallis.) (Dublin Shore, N. S., Mr. Engelhart.)

Genitalic Slides: 1, Peru, N. Y.

This is the only Agrotid in the fauna of Boreal America with bright yellow-orange hind wings, margined terminally by a broad black band; and with the fore tibiae unspined.

It is interesting to note that the male genitalia are decidedly different, and in some respects at least, far more rudimentary than those of any species of the genus Lampra studied by the author. The valves are short, lobate, without arms, the ampulla of the clasper is very strongly chitenized, long and [illegible] and the sacculus is not definitely present. While the author would not attempt to base genera on genitalic characters of the males, such a strikingly different genitalia appears vastly significant.

The author has followed Sir George Hampson in considering that *gilvipennis* and *chardinyi* deserve a genus to themselves. The necessity for the designation of a new generic name in place of Hampson's usage of Rhynchagrotis is fully explained in the introduction to the genus Lampra. Suffice it here to repeat that Rhynchagrotis, Hampson (Smith in part) is invalid for application to *gilvipennis* and *chardinyi,* Dr. Smith having fixed the type of Rhynchagrotis as *cupida;* (Bull. XXXVIII, U. S. N. M., page 9).

The characters given herewith; in the generic description copied from Hampson, with additions and corrections; together with the original description; completely cover all specific characters for *gilvipennis.* The habitat of true *chardinyi,* E. Prussia to W. Siberia, throws it out of the range of species treated in this paper.

LIST OF GENERA, SUBGENERA, GROUPS, SPECIES, FORMS, ABERRATIONS AND SYNONYMS TREATED IN THIS PAPER

LAMPRA Hbn.

ABAGROTIS Sm.

1.—erratica, *Sm.*
  form ornatus, *Sm.*
2.—alcandola, *Sm.*
  tristis, B. & McD.
3.—bimarginalis, *Grt.*

LAMPRA Hbn.

GROUP VITTIFRONS

4.—vittifrons, *Grt.*

GROUP TRIGONA

5.—trigona, *Sm.*
6.—sambo, *Sm.*

GROUP MIRABILIS

7.—mirabilis, *Grt.*

GROUP DISCOIDALIS

8.—discoidalis, *Grt.*

GROUP PLACIDA

9.—placida, *Grt.*
  ab. mi[illegible]malis, *Grt.*

G[illegible]P NEFASCIA

10.—b[illegible], *n. sp.*
  [illegible] nevadensis, *n. form.*
11.—for[illegible], *n. sp.*
12.—du[illegible]a, *Sm.*
13.—nefascia, *Sm.*

GROUP VARIATA

14.—variata, *Grt.*
  varix, Grt.
  ab.—orbis, *Grt.*
15.—scopeops, *Dyar.*

GROUP ALTERNATA

16.—alternata, *Grt.*

GROUP INSULARIS

17.—insularis, *Grt.*
  form confusa, *Sm.*

GROUP EXSERTISTIGMA

18.—exsertistigma, *Morr.*
form observabilis, *Grt.*
form formalis, *Grt.*
form facula, *Grt.*
form niger, *Sm.*
form meta, *Sm.*
form emarginata, *Grt.*
form carissima, *Harv.*
form inelegans, *Sm.*
form cupidissima, *Grt.*
ab.—laetula, *Grt.*
distracta, Sm.
form morrisonistigma, *Grt.*
binominalis, Sm.
crenulata, Sm.

GROUP ANCHOCELIOIDES

19.—cupida, *Grt.*
velata, *Wlk.*
form brunneipennis, *Grt.*
20.—belfragei, *Sm.*
21.—anchocelioides, *Gn.*

GROUP BRUNNEICOLLIS

22.—brunneicollis, *Grt.* } *hero, Morr. (?)*
23.—rufipectus, *Morr.* }

CRYPTOCALA n. gen.

1.—gilvipennis, Grt.

SPECIES TRANSFERRED TO OTHER GENERA.

Agrotis costata, Grt. This is a Euxoa; placed in the Barnes collection between furtiva and servitus. Authority—one specimen compared with type by Sir George Hampson, its label reading—"♀ like type costata which is without head and is from same locality; it is a Euxoa near *furtiva,* Smith."

Rhynchagrotis orbipuncta, B. & McD. This is apparently an Agrotis, *Hamp. & Auct.,* but fits nowhere in our present series. Temporarily placed by author and Dr. Lindsey between *subporphyrea* and *larga* in the Barnes collection. Authority, personal examination of Holotype ("Type ♂"), Allotype ("Type ♀") and four ♀ Paratypes.

PHYLOGENY OF THE GENUS LAMPRA, Hbn.

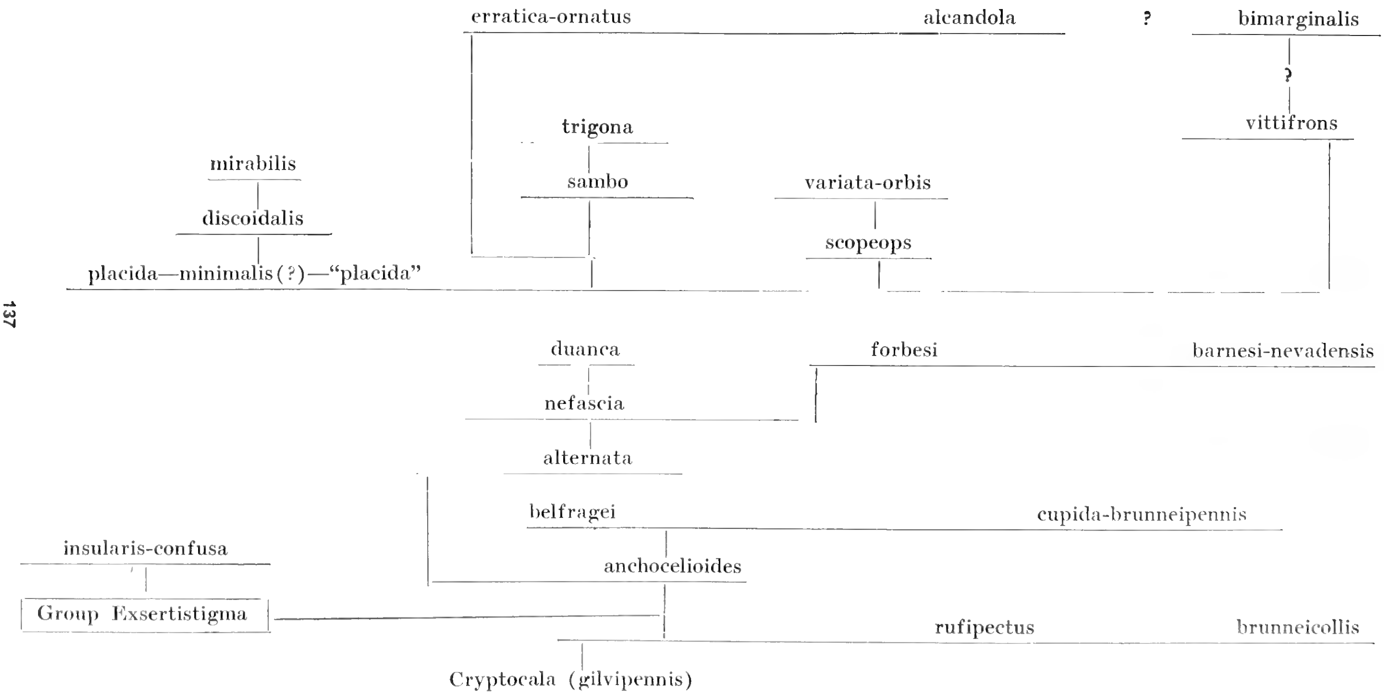


PLATE 1. GENITALIA

LAMPRA

ABAGROTIS

1.—erratica, *Sm.*

2.—alcandola, *Sm.*

3.—bimarginalis, *Grt.* 3a.—penis.

LAMPRA

4.—vittifrons, *Grt.* 4a.—penis.

5.—Trigona, *Sm.* 5a.—penis.

6.—mirabilis, *Grt.* 6a.—penis.

7.—discoidalis, *Grt.*

8.—placida (N. Y.) *Grt.* 8a.—penis. 8b.—penis of one Western form of "placida."

PLATE 1. GENITALIA

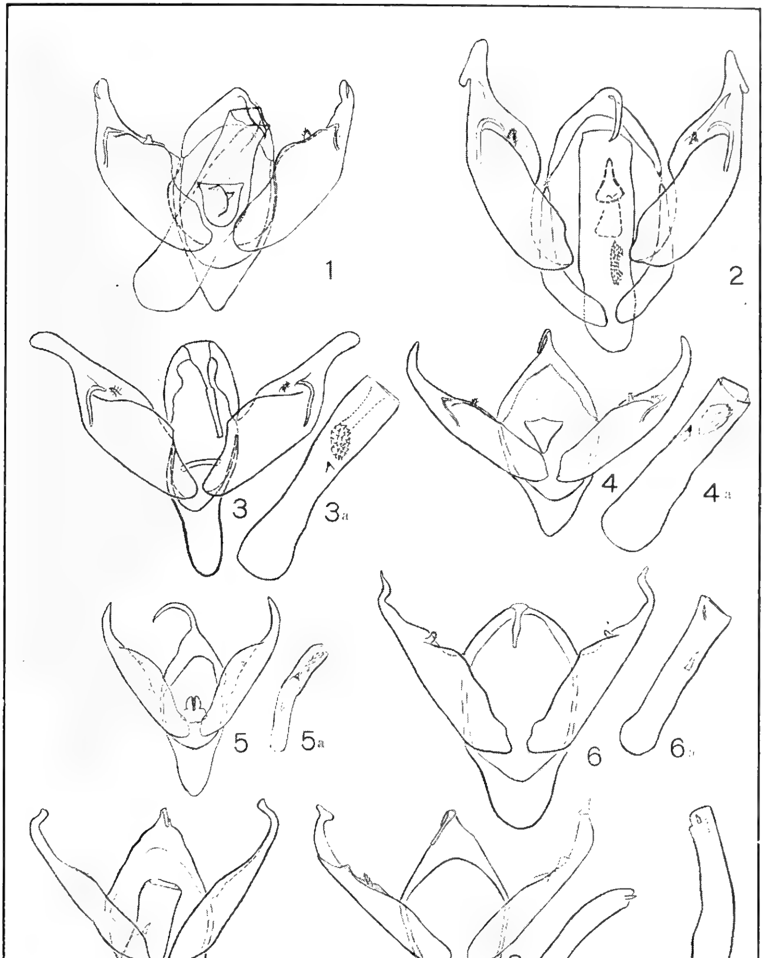


PLATE 2. GENITALIA

LAMPRA

9.—barnesi, *n. sp.*, Holotype.
9a.—penis.

10.—forbesi, *n. sp.*, Holotype.
10a.—penis.

11.—duanca, *Sm.*, Topotype.
11a.—penis.

12.—nefascia, *Sm.* 12a.—penis.

13.—variata, *Grt.* 13a.—penis.

14.—scopeops, *Dyar.* 14a—penis.

15.—alternata, *Grt.* 15a.—penis.

16.—insularis *form* confusa, *Sm.*
16a.—penis.

PLATE 2. GENITALIA

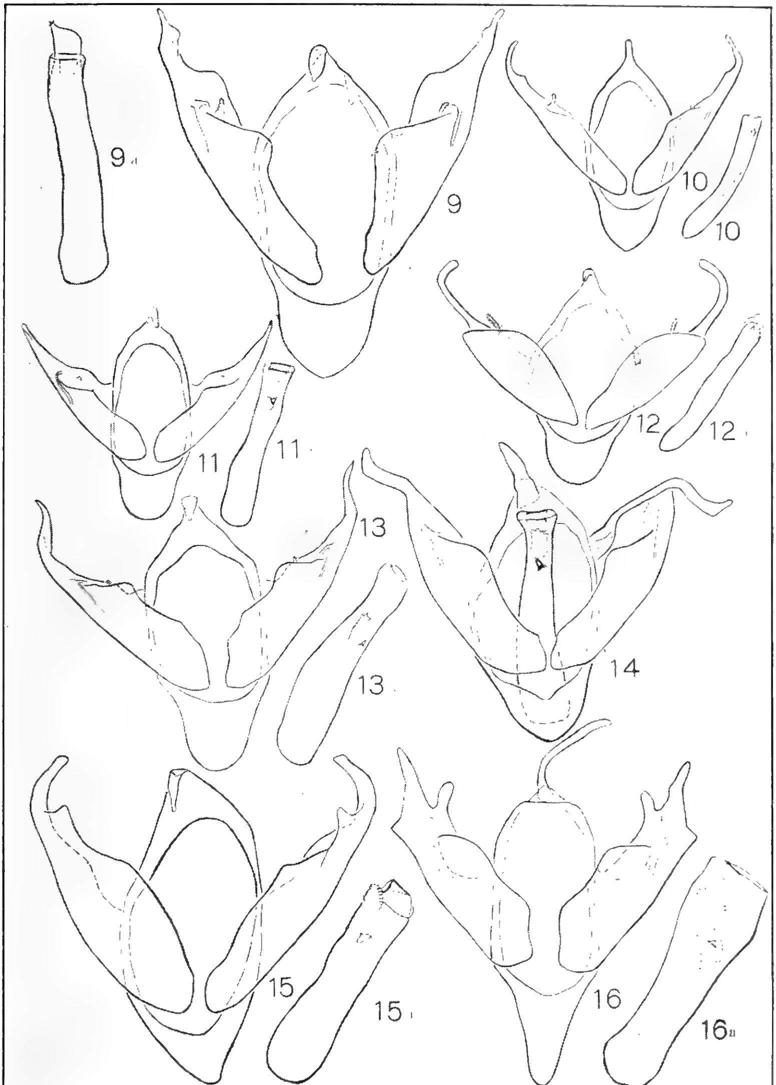


PLATE 3. GENITALIA

LAMPRA

17.—exsertistigma, *Morr.*
17a.—penis.

18.—exsertistigma *form* formalis, *Grt.* 18a—penis.

19.—exsertistigma *form* facula, *Grt.* 19a.—penis.

20.—exsertistigma *form* niger, *Sm.* 20a—penis.

21.—exsertistigma *form* emarginata, *Grt.* 21a.—penis.

22.—exsertistigma *form* inelegans, *Sm.* 22a—penis.

23.—exsertistigma *form* cupidissima, *Grt.* 23a—penis. 23b.—tip of valve of another specimen showing individual variation.

24.—exsertistigma *form* cupidissima *ab.* laetula, *Grt.* (distracta, *Sm.*) 24a.—penis

PLATE 3. GENITALIA

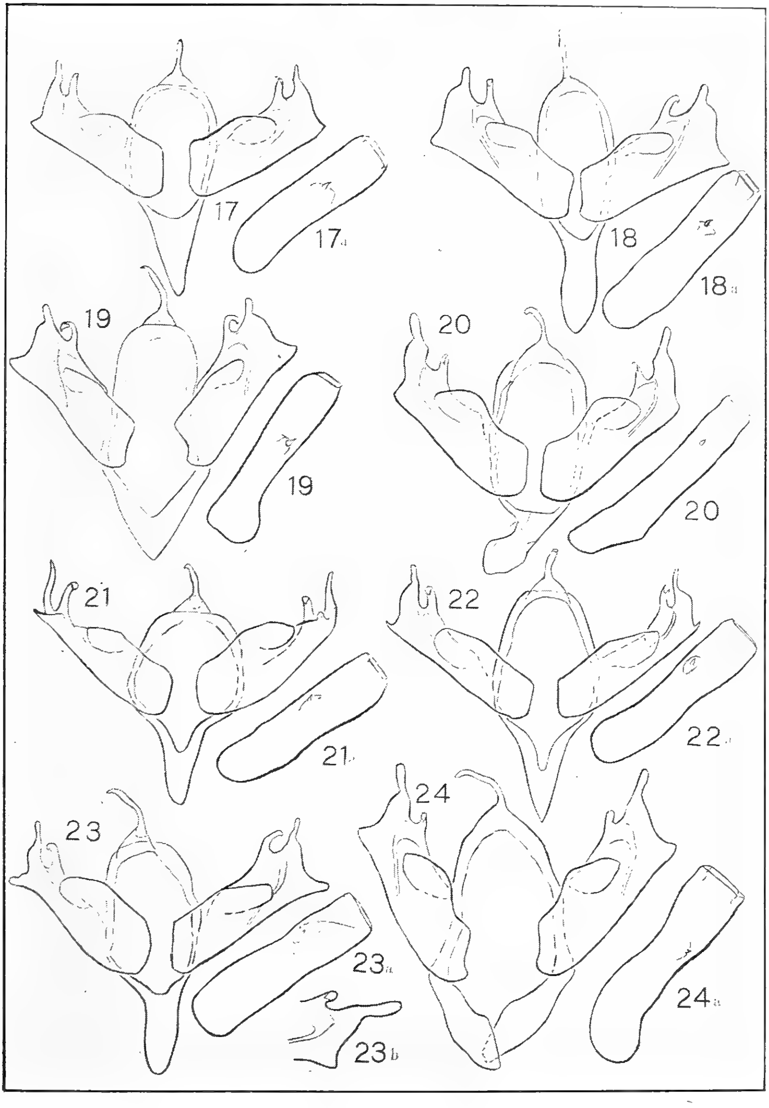


PLATE 4. GENITALIA

LAMPRA

25.—exsertistigma *form* morrisonistigma, *Grt.* 25a—penis.

26.—cupida, *Grt.* 26a.—penis. 26b.—tip of valve of another specimen showing individual variation.

27.—belfragei, *Sm.* 27a.—penis.

28.—anchocelioides, *Gn.* 28a.—penis. 28b.—tip of valve of another specimen showing individual variation.

29.—brunneicollis, *Grt.* 29a.—penis.

30.—rufipectus, *Morr.* 30a.—penis.

Cryptocala

31.—gilvipennis, *Grt.* 31a.—penis.

PLATE 4. GENITALIA

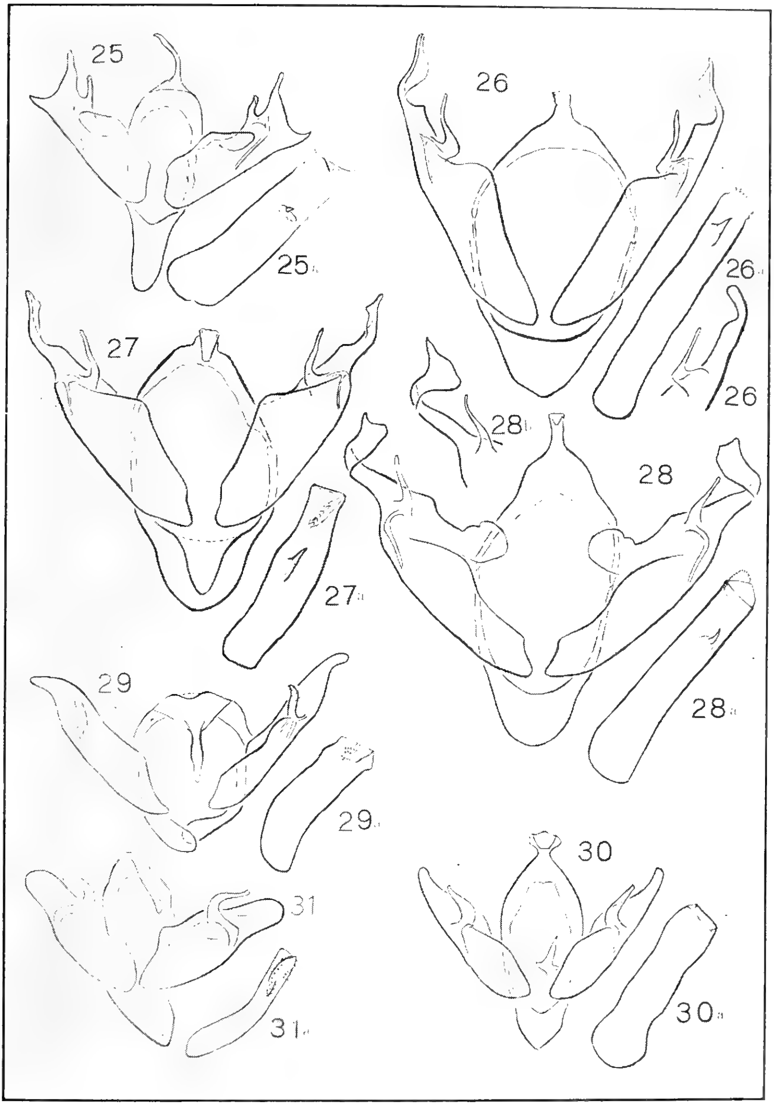


PLATE 5. ADULTS

LAMPRA

ABAGROTIS

32.—*erratica*, Sm. ♂, Truckee, Calif.

33.—*erratica* form *ornatus*, Sm. ♂, Kaslo, B. C.

34.—*alcandola*, Sm. ♂, Santa Catalina Mts., Ariz.

35.—*bimarginalis*, Grt. ♂, Jemez Springs, N. Mex.

LAMPRA

36.—*vittifrons*, Grt. ♂, Colo. (Bruce) (ex. Doll Coll.).

37.—*trigona*, Sm. ♂, Arizona.

38.—trigona, Sm. ♀, Colo (Bruce) ex. Coll. Smith) obtained by author from Staudinger & Bang-Haas under name of R. cupidissima.

39.—*sambo*, Sm. ♂, round date lable only. 3. VII. 05., labeled R. minimalis. by .Dr. Smith. Kindly sent by E. H. Blackmore, F.E.S.

40.—*sambo*, Sm. ♀, Vernon Dist., B. C. Kindly sent by E. H. Blackmore, F.E.S.

41.—*mirabilis*, Grt., ♂, Glenwood Springs, Colo.

42.—*discoidalis*, Grt. ♀, Vineyard, Utah, (Spaulding) Coll. Auct.

43.—*placida*, Grt. ♂, Franklin County, N. Y., (C. S. McKnight).

44.—*placida*, Grt. ♀, Deer Creek, Provo Canyon, Utah, (Spaulding) Coll. Auct.

45.—*placida*, ab. *minimalis*, Grt. ♀, dark form, Wallace, Idaho, (Huelleman) Coll. Auct.

PLATE 5. ADULTS

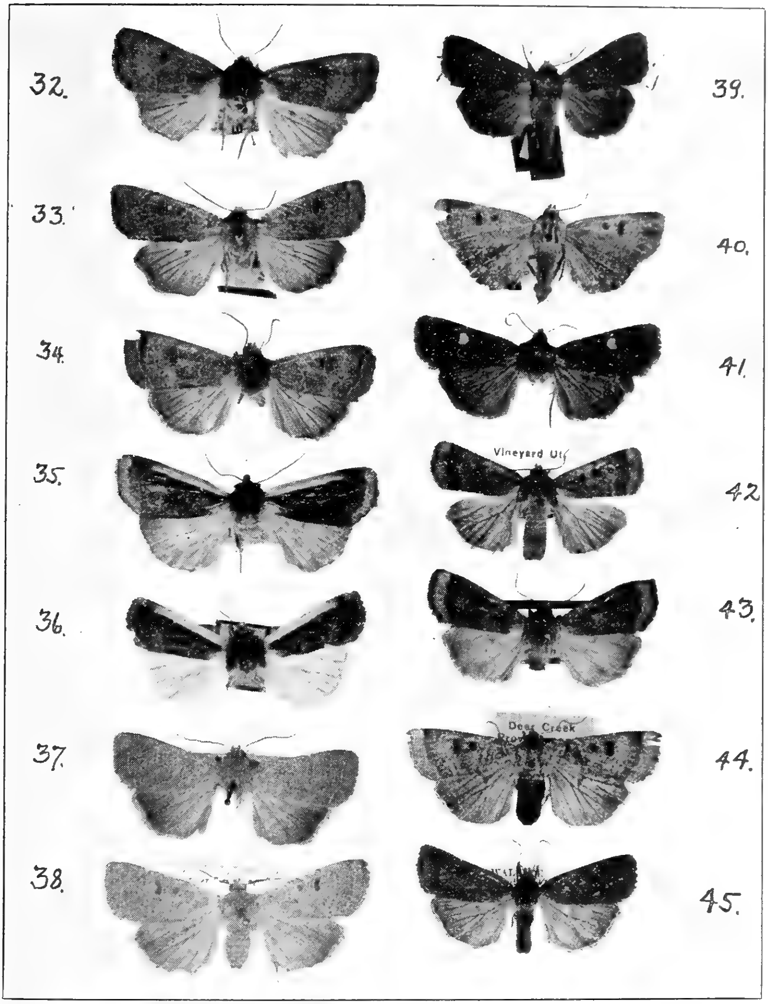


PLATE 6. ADULTS

LAMPRA

46.—*barnesi,* n. sp. Holotype ♂, White Mts., Ariz.

47.—*barnesi,* ♂, close to form *nevadensis,* Mission San Jose, Calif., (Miss Lowrie). *L. barnesi nevadensis* differs from this ♂ in that the ordinary spots and lines are even more suffused into the general ground color and hardly visible.

48.—*forbesi,* n. sp. Holotype ♂, Stockton, Utah, (Spaulding).

49.—*duanca,* Sm. Topotype ♂, Stockton, Utah, (Spaulding).

50.—*nefascia,* Sm. ♂, Hunters, Washington, (E. Nelson).

51.—*nefascia,* Sm. ♂, Provo, Utah, (Spaulding). This form of L. nefascia strongly resembles the red form of L. forbesi, but usually the orbicular is slightly smaller, clearer outlined, and rounder in the latter species.

52.—*variata,* Grt. ♂, Vineyard, Utah, (Spaulding) ex. Coll. Auct.).

53.—*variata,* Grt. ♂, dark form, resembling scopeops, Victoria, B. C. Kindly sent by E. H. Blackmore, F.E.S.

54.—*scopeops,* Dyar. ♂, Kaslo, B. C., labeled scopeops, Dyar, G. F. H. See text in regard to further data about this specimen.

55.—*scopeops,* Dyar. ♂, Tehachapi, Kern Co., Calif. See text.

56.—*alternata, Grt. , Provo, Utah,* (Spaulding). This form might easily be confused with belfragei on superficial examination, but the orbicular is not round as is that of the latter species.

57.—*alternata,* Grt. ♂, Columbus, Ohio.

58.—*alternata,* Grt. ♂, Glenwood Springs, Colo.

PLATE 6. ADULTS

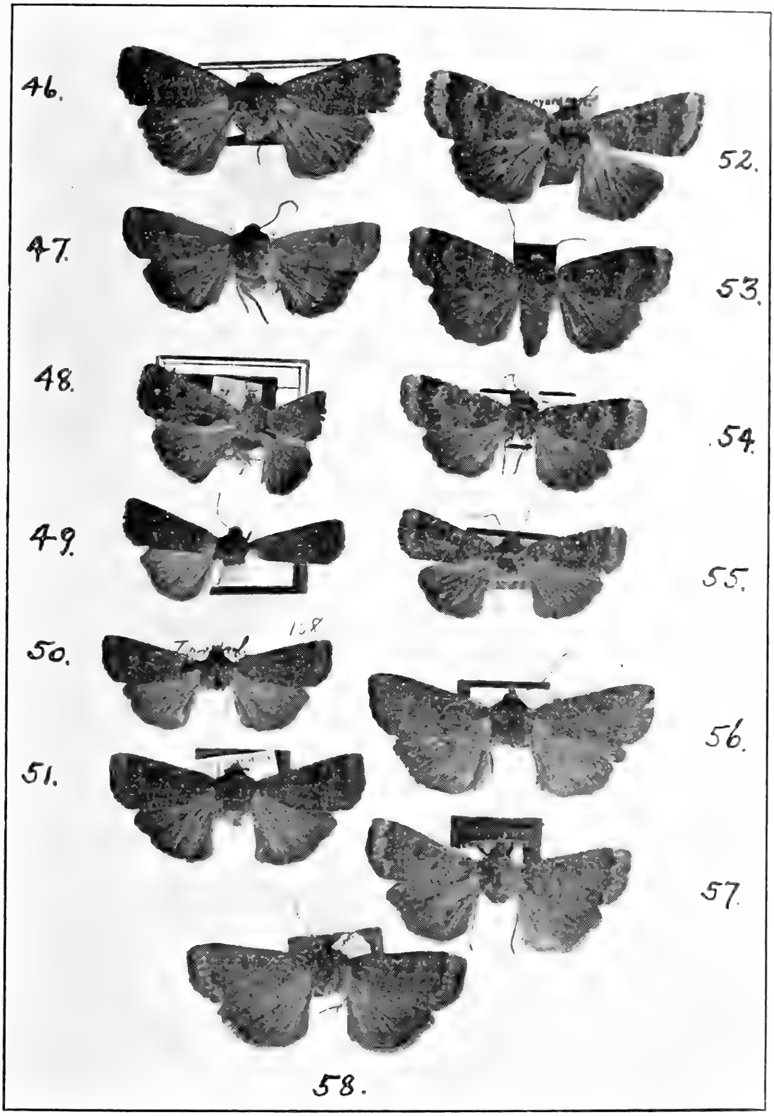


PLATE 7. ADULTS

LAMPRA

59.—*insularis*, Grt. ♂, Victoria, B. C. Kindly sent by E. H. Blackmore, F.E.S.

60.—*insularis*, from transitional to *confusa*, Sm. ♂, Victoria, B. C. Kindly sent by E. H. Blackmore, F.E.S.

61.—*insularis* form *confusa*, Sm. ♀, Victoria, B. C. Kindly sent by E. H. Blackmore, F.E.S.

62.—*insularis* form *confusa*, Sm. ♀, pale form, Victoria, B. C. Kindly sent by E. H. Blackmore, F.E.S.

63.—*exsertistigma*, Morr. ♂, Middle, Calif.

64.—*exsertistigma* form *observabilis*, Grt. ♀, Victoria, B. C. Kindly sent by E. H. Blackmore, F.E.S.

65.—*exsertistigma* form *formalis*, Grt. ♂, San Francisco, Calif., (Mueller), labeled Triphaena, formalis, Grt. agrees with type, G.F.H.

66.—*exsertistigma* form *facula*, Grt. ♂, Calif. labelled Triphaena facula, Grt. agrees with type, G.F.H.

67.—*exsertistigma* form *niger*, Sm. ♂, Camp Baldy, San Bernardino Mts., Calif.

68.—*exsertistigma* form *emarginata*, Grt. ♂, Middle, Calif.

69.—*exsertistigma* form *inelegans*, Sm. ♂, Middle, Calif.

70.—*exseritstigma* form *inelegans*, Sm. ♀, dark form, Ukiah, Calif. Coll. Auct.

71.—*exsertistigma* form *cupidissima*, Grt. ♂, Middle, Calif., labeled cupidissima, Grt., type a little redder, G.F.H.

72.—*exsertistigma* form *laetula*, Grt. =*distracta*, Sm. ♂, Seattle, Wash., labeled A. observabilis, Grt. (See text).

PLATE 7. ADULTS

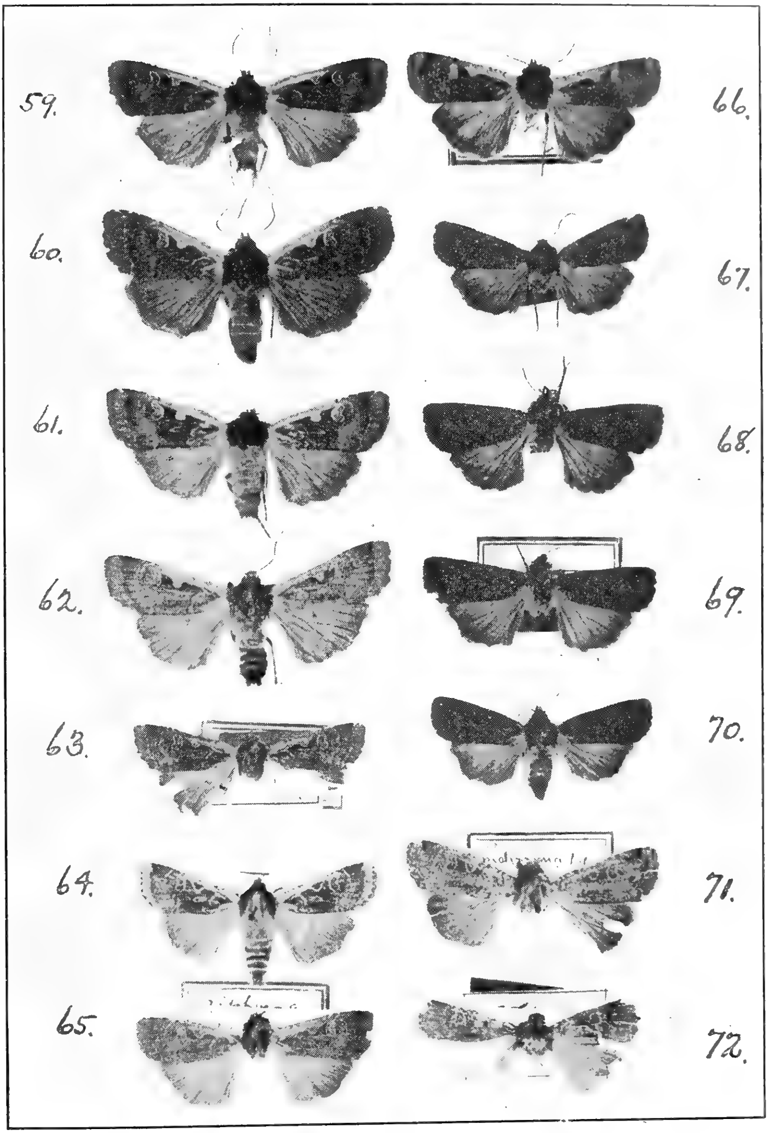


PLATE 8. ADULTS

LAMPRA

73.—*exsertistigma* form *morrisonistigma*, Grt. ♂, Calif.

74.—*cupida*, Grt. ♀, Dublin Shore, Nova Scotia (ex. Coll. G. P. Engelhardt) Coll. Auct.

75.—*cupida*, Grt. ♀, ab.—as described by Sir George F. Hampson, Cat. Lep. Phal. B. M., IV—Browns Mills in the Pines, N. J. (Benjamin) Coll. Auct.

76.—*cupida* form *brunneipennis*, Grt. ♂, Browns Mills in the Pines, N. J. (Benjamin) Coll. Auct.

77.—*belfragei*, Sm. ♂, Texas, (Coll. Belfrage) (ex. Coll. C. V. Riley) (ex. Coll. U. S. N. M.).

78.—*anchocelioides*, Gn. ♂, Columbus, Ohio.

79.—*brunneicollis*, Grt. ♂, Concord, Mass., (Reiff).

80.—*rufipectus*, Morr. ♂, Richmond Hill, L. I., (ex. Coll. Doll).

81.—*rufipectus*, Morr. ♂, White Mts., Ariz.

CRYPTOCALA

82.—*gilvipennis*, Grt. ♂, Revilstoke, B. C., kindly sent by E. H. Blackmore, F.E.S.

83.—*gilvipennis*, Grt. ♂, Dublin Shore, Nova Scotia, (ex. Coll. G. P. Engelhardt) Coll. Auct.

84.—*chardinyi*, Bdv. ♂, Coll. Auct. via Staudinger & Bang-Haas.

85.—*chardinyi* Bdv. ♀, Coll. Auct. via Staudinger & Bang-Haas.

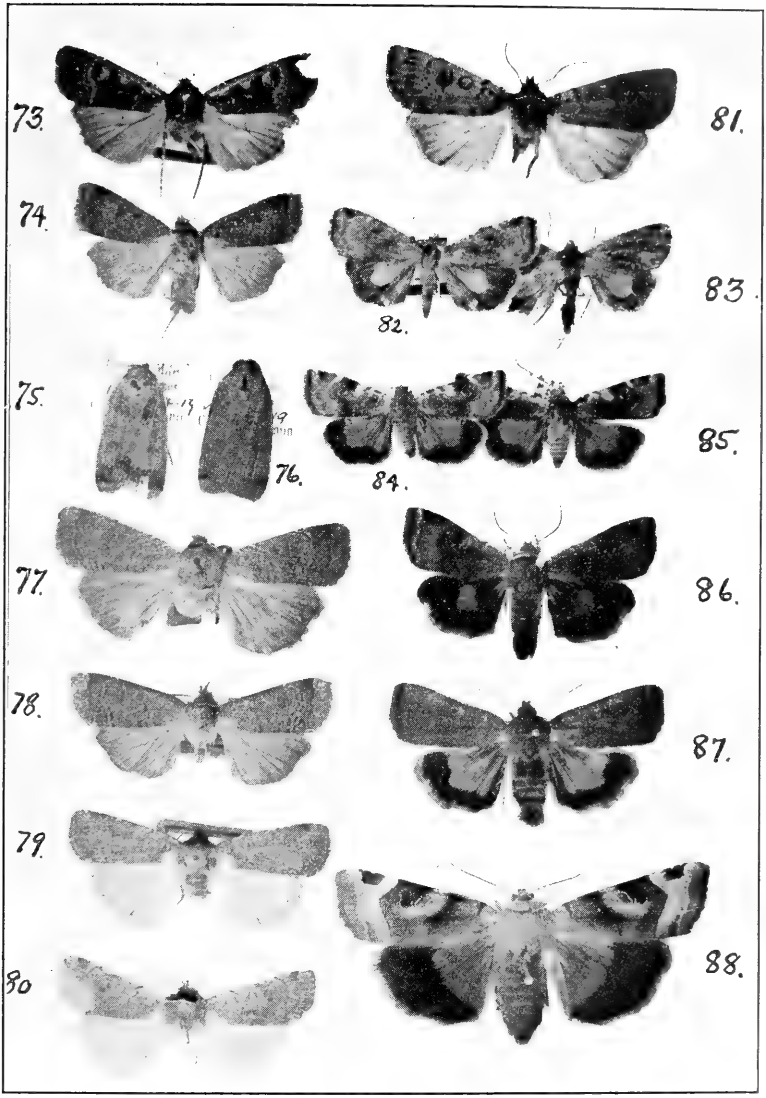
LAMPRA

86.—*janthina*, Schiff. ♀, Berg Petersen, Coll. Auct. via Staudinger & Bang-Haas.

87.—*interjecta*, Hbn. ♂, Lausitz, Saxony, Coll. Auct. via Staudinger & Bang-Haas.

88.—*fimbria*, Linn. ♂, Dresden, Germany, Coll. Auct. via Staudinger & Bang-Haas. (Genotype.).

PLATE 8. ADULTS



ADDENDA

The following species from various localities in British Columbia were received from E. H. Blackmore, F.E.S., too late to include in the text under the various species, but some have served for illustrations:

Lampra (Abagrotis) erratica ornatus, Sm., 2 ♂, 2 ♀.
Lampra (Lampra) exsertistigma, Morr., 2 ♂.
L. exsertistigma observabilis, Grt., 2 ♀.
L. exsertistigma morrisonistigma, Grt., 3 ♂.
L. exsertistigma, faeula, Grt., 6 ♂, 2 ♀.
L. exsertistigma niger, Sm., 5 ♂, 4 ♀.
L. insularis, Grt., typical, 1 ♂.
L. insularis transitional to confusa, Sm., 7 ♂, 3 ♀.
L. insularis confusa, Sm., 1 ♂, 8 ♀.
L. nefascia, Sm., 5 ♂, 9 ♀.
L. placida, Grt., 1 ♂, 5 ♀.
L. placida, Grt., var. resembling scopeops, Dyar, 1 ♂, 5 ♀.
L. sambo, Sm., 1 ♂, 7 ♀.
L. trigona, Sm.?, 2 ♀.
L. variata, Grt., 1 ♂, 3 ♀.
L. rufipectus, Morr., 2 ♀.
L. vittifrons, Grt., 1 ♂.
Cryptocala gilvipennis, Grt., 1 ♂.

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"	9,	"	2.	July,	1910	.75
"	10,	"	2.	July,	1911	.75
"	12,	"	1.	January,	1913	.50
"	13,	"	1.	January,	1914	.75
"	13,	"	2.	July,	1914	.75
"	14,	"	1.	January,	1915	.75
"	15,	"	2.	July,	1916	.50
"	16,	"	1.	January,	1917	.75
"	16,	"	2.	July,	1917	1.00
"	17,	"	2.	July,	1918	.75
"	18,	"	1.	January,	1919	1.00
"	18,	"	2.	July,	1919	.75
"	19,	"	1.	January,	1920	.25
"	19,	"	4.	October,	1920	.25
"	20,	"	1.	April,	1921	.25
"	20,	"	2.	August,	1921	.25
"	20,	"	3.	December,	1921	.25

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Dr. John A. Comstock, *Secretary.*

Southern California Academy of Sciences, Southwest Museum
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BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Vol. XXI Part I
March, 1922

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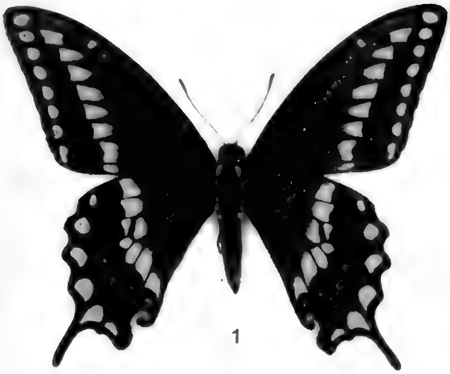
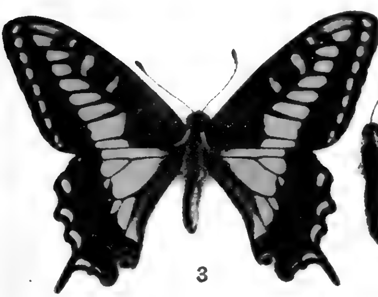


1

BAIRD'S SWALLOWTAIL
(*Papilio bairdi*) ♂

2

BAIRD'S SWALLOWTAIL
(*Papilio bairdi*) ♀

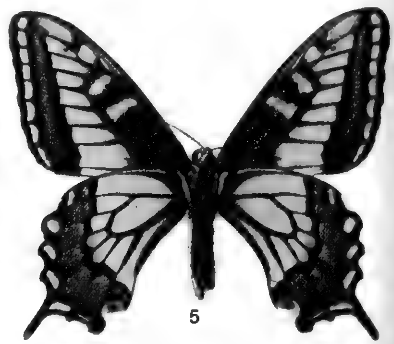


3

The ANISE SWALLOWTAIL
(*Papilio zelicaon*) ♂

4

The ANISE
SWALLOWTAIL ♀



5

The ANISE SWALLOWTAIL
(*P. zelicaon*) Under side ♀

6

The SHORT-TAILED
SWALLOWTAIL (*P. indra*) ♂

7

(*Papilio indra*) ♂
Under side.

8

The SHORT-TAILED
SWALLOWTAIL (*P. indra*) ♀

The SWALLOWTAILS

ABOUT 2/3 NATURAL SIZE.

A GIANT PALM-BORING BEETLE—Dinapate Wrightii

By Dr. John A. Comstock

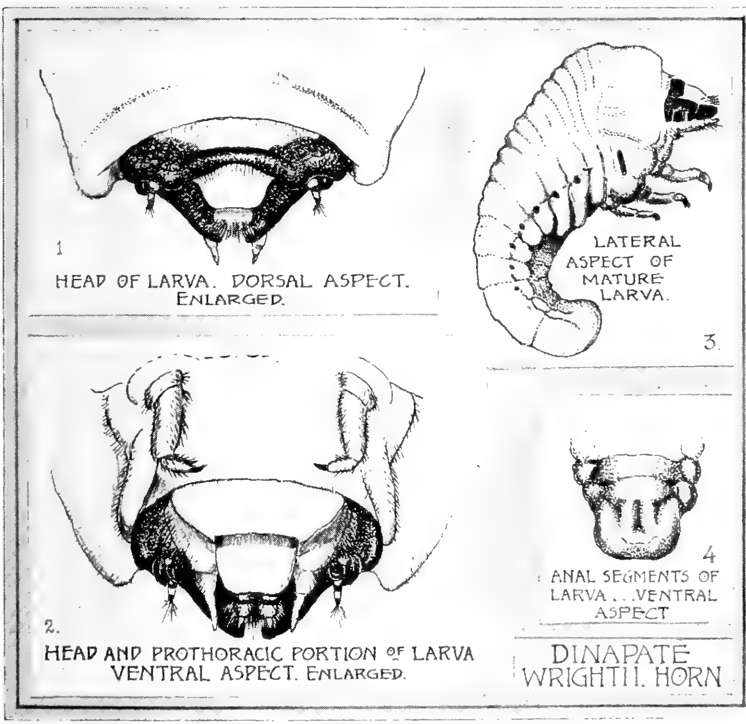
Illustrations by the author

One of the most interesting, and also one of the rarest insects occurring in California is the palm-boring beetle known as Dinapate wrightii. His nearest relatives are all inconspicuous diminutive fellows, but for some unknown reason this hermit of his tribe has attained most generous proportions. So far as known he occurs only in the canyons debouching into the Coachella valley, where grows the Washingtonia palm (Neowashingtonia filifera).

Several papers have appeared in scientific journals from time to time dealing with this exclusive resident of our desert valley, but these are for the most part rare technical publications that are not likely to come under the notice of our California naturalists.

It will therefore be of profit to cull from these papers the main points of interest, both technical and general, and group them in one inclusive article.

PLATE A.



This beetle was first described by Dr. George H. Horn, in Transactions of the American Entomological Society, Vol. XIII, pp. 1-4, 1886.

After erecting and defining a new genus in which to place the species Dr. Horn then writes:

"D. wrightii—n.sp—Black, shining, beneath brown sparsely pubescent; head broader behind the eyes, finely punctate, a vague median frontal impression; thorax oboval broader than long, nearly as wide as the elytra, very convex, densely granulate in front and posteriorly, roughly asperate at the sides anteriorly; elytra parallel, declivous posteriorly, the apices sinuately truncate, the sutural angle acute, the disc vaguely bicostate, the costal terminating in tuberculiform elevations (♀) or with the inner costa prolonged in a spine (♂), the surface above with shallow cribrate puncture, the sides smoother and with two indistinct costae beneath the humeral umbone; legs moderate, femora sparsely punctate; body beneath rather finely punctate, the abdomen more densely and with pale brownish pubescence. Length 1.50–1.86 inch; 38–47^{mm}."

"The measurements are taken from the apex of the elytra to the anterior margin of the thorax; the smaller specimens are females. A size is thus indicated exceeding any Bostrichide known."

"For the fragments in my possession I am indebted to the untiring exertions of Mr. W. G. Wright, of San Bernardino, Cal., a zealous Botanist, for whom neither the privations incident to an exploration of the Mojave Desert nor the jealous watchfulness of the Indians, seemed to have had any terrors."

"Mojave Desert, California."

The locality "Mojave Desert" was given Dr. Horn by the eccentric pioneer naturalist, W. G. Wright, who was a zealous collector but lacked the true scientist's viewpoint of wishing to share his discoveries with the world. Wright was always secretive as to the localities where he found his rare specimens, probably out of fear that others would be led to his pet hunting grounds.

Dr. Horn gave a description of the larva of Dinapate wrightii, in the article above referred to. This was as follows:

"Form robust, convex, the ventral surface flat, gradually narrower from the prothoracic to the last segment, the last four segments recurving, their ventral surface in contact with that of the preceding segments; color whitish, consistence soft.

Segments twelve; three thoracic, nine abdominal.

Prothorax large, massive, somewhat narrowed in front, flat above, yellowish white, a dorsal and two lateral fuscous spaces, the latter including an elevated serrate line; spiracle large, fusiform in outline.

Meso and *Metathoracic* segments consisting of a dorsal and infero-lateral piece, the latter as seen from the side larger; these segments without spiracles.

Abdominal segments. The first two consist of two dorsal pieces, the division indicated by a fold merely, the spiracles in these segments smaller than the prothoracic and situated in a rhomboidal depression between the dorsal and infero-lateral plates; segments three to eight gradually less

divided on the dorsal portion, the spiracles in each gradually smaller and situated at the lower end of the dorsal division. Last segment obtusely ovate, scarcely plicate dorsally and without spiracle, the anal opening ventral and longitudinal.

Spiracles. Of these there are nine on each side, all functional; the first is situated at the side of the prothoracic segment, the others in the first eight ventral segments; they gradually decrease in size from the first to the last.

Legs. On the three thoracic segments nearly equal, with four articulations, the femoral piece longer, the tibia terminated by a small cleft claw, the under portion of which is short; surface of legs rather hairy.

Head very deeply inserted in the prothorax; the exposed portion dark chitinous, the internal ovate flattened on the underside, the anterior margin of head forming a thickened projection, the clypeus hemi-hexagonal with a chitinous border.

Labrum transverse, ciliate, the anterior margin arcuate.

Mandibles stout, pyramidal, the apices chisel shaped, transversely wrinkled above; behind the base of the mandibles an oval tubercle of the side of the head.

Maxillae with a large, irregularly quadrangular, basal piece, surmounted by an oval lobe, the inner edge of which is truncate, the surface densely ciliate; the palpi 3-jointed, the first largest, obovate, second narrower and shorter, the third slender, subuliform.

Mentum trapezoidal, the sides arcuate, apex truncate, face obliquely impressed each side; the submentum broader, of the same general form; palpi similar to the maxillary, but much swollen, the ligula concealed by them, semi-circular, the palpi and ligula rather densely pilose.

Antennae small, situated near the base of the mandibles above the oval subercle, 3-jointed, the first joint short, cylindrical, second narrower and longer, the third small, slender and bisetose at tip.

This larva reproduces the form and nearly all the details of Apate capucina as published by Perris (Ann. Fr. 1850, pl. XVI, I). The antennae are there described as 4-jointed, but the conical basal piece as described seems rather to be the protuberant connecting membrane. The other parts figured by Perris are rather diagrams than real illustrations. The accompanying figures will give a fair idea of the imago and the larva, obviating the necessity for a very detailed description.

The head of the larva is remarkable in its size and the perfection of the mouth parts. It is entirely without trace of visual organs, although it is probable that the post-mandibular tubercle becomes the eye in the imago.

It is probable that the larva figured on the accompanying plate is fully grown. Two specimens were kindly sent me by Mr. W. G. Wright, one of which will be placed in the Museum of Comparative Zoology at Cambridge, for the use of those who have occasion to study the instructive series of larvae there accumulated."

The illustrations accompanying Dr. Horn's article were not particularly satisfactory, being too diagrammatic and somewhat out of proportion. He probably had only alcoholic preparations of the larva from which to work.

The next article of interest on this subject was a series of letters published in the Entomological News, Vol. X, 1899, P. 83, from H. G. Hubbard. I will extract from these such passages as may shed light on the habits, etc., of this beetle.

Referring to Palm Canyon (under date of Feb. 8, 1897) Hubbard says:

"The Washingtonia palms (Neowashingtonia filifera) in this small canyon are few in number, several hundreds perhaps strung along in a straggling line and most of them burned by the Indians who set fire to the fans as a smoke offering to their dead. There are very few young palms, as the freshets wash away most of the seed. However, there are occasional clumps of not very old plants on the higher benches and these are sheathed with immense accumulations of dead fans. Every part of this tree is so huge and tough that I, with my small hatchet, can make but little impression upon it. Even to cut through one of the handles of the dead leaves is almost beyond my strength, and where there are accumulations of leaves upon the ground, the long handles armed with knife-like points are so interwoven, that it is a severe task to overturn them. I found no living specimen of Dinapate in any stage, but I uncovered a dead and disintegrated specimen of this gigantic Bostrychid beetle lying between dead fans at the foot of a young palm. Many of the old palms are uprooted by the flood waters, and I saw probably 50 of these prostrate trunks upon the ground. Almost all of them are perforated all over, with round open holes, into most of which I can insert the end of my thumb. Some of the holes will, however, only admit the little finger. These holes evidently made by Dinapate larvae open directly into a huge pupa chamber which is two inches long and lies vertically with the grain not more than one or two inches from the surface. The remainder of the gallery is solidly packed with sawdust and leads into such a labyrinth of borings into the interior that most of the attacked logs are completely riddled, and at the heart there is very little of the original texture left. So solid is the sawdust, however, that these bored logs hardly lose any of their strength and, in fact, are used as gate posts at several of the ranches and at the hotel at the Springs, where the people think the holes are made by carpenter bees (Xylocopa). It is very certain that a log once vacated by a colony of Dinapate is never afterwards entered or again attacked by them. I should say that most of the logs showed from 100 to 250 exit holes of the beetle, and, at the time of emergence, the person lucky enough to discover such a colony would find no difficulty in filling several Mason jars with the beetles. Of course, until they begin to emerge, there is no sign upon the outside of the presence of the insects within a palm trunk. I could find no trace of the living larvae and heard no sound of them in unperforated logs."

"Several logs, which Mr. W. (Wright) has laid open to the heart, gave me an excellent chance of examining the old borings of the beetle, and I found some dead larvae and always, in each gallery examined, the pair of great jaws and the clypeus of the larva packed in the sawdust at the bottom of what was the pupal cell."

"I think, from my own observation and the evidently fruitless visits of Mr. Wright, that colonies of the beetle are rare and very hard to find. This is probably its northern limit, but in Baja California it may possibly be more abundant."

Under date of February 27th, 1897, Hubbard wrote:

"I found in Andreas canyon a thorax of Dinapate, in a pile of stream drift, showing that the beetle occurs there. I finally left the main canyon and crawled over a divide into a still smaller valley, also very difficult, but within half a mile I found a group of seven of the most magnificent palms, 70 to 80 feet high, and clothed with dead fans from foot to crown so that they looked like huge towers. It is the first time I have seen this magnificent tree in full size and with all the fans still clinging to it. It seems almost beyond the strength of a man to penetrate these dense coverings of dead fans which cover the trunks 8 to 10 feet thick on every side so that the diameter of the covered trunk is often 20 feet. I found in this little side canyon among the group of living palms a single huge dead fallen trunk which had lain prostrate many years and had been covered up with grape vines and leaves of the cottonwoods. This trunk was so entirely disintegrated that I was able to pull it away in pieces with my hands. It was bored in every direction with Dinapate galleries, and I had at last the good fortune to find, still in its pupal cell, a dead specimen of the beetle, the chitin of which was still perfect, but every ligament dissolved away so that the different sclerites adhered loosely in the surrounding sawdust. I found the specimen to be a male and preserved two small curiously twisted chitinous claspers which were within the abdomen.

"Yesterday, accompanied by an Indian, I visited again Palm canyon and made straight for a certain palm tree which I had observed on my first visit, but too late in the day for a close examination. This is a young tree, not over 20 feet high, and still retains its clothing of fans. It is dead but the bud leaves are still in place. It has evidently been killed by something, and I cannot help suspecting that this has been done by the females of Dinapate before depositing their eggs. No living tree is ever attacked by them, nor do they enter any trunk that has been long dead or fallen or cut down. I suspect that the female cannot deposit her eggs in any trunk deprived of leaf bases.

"In this young palm examined by me the trunk was of very large diameter, and the first chips we removed with our axes showed galleries of Dinapate of full size and filled with frass quite fresh and light in color. together with evidently much older galleries of smaller size in which the frass had turned dark with age. I found some of the small borings at their beginning under the fibres of the leaf bases, where they were not larger than a friction match. We finally uncovered a living larva of Dinapate, full-grown and apparently forming its pupa cell or preparing to do so. After several hours' work we secured four specimens, only one of which could be taken out uninjured, the other three specimens being more or less cut to pieces or crushed between the tough fibres. All these larvae were thoroughly dormant and very flaccid; evidently they had eaten nothing for some months.

"I feel sure that they are more than one year and probably more than two years old, but no doubt they would have issued by July or August of this year. All the larvae in this trunk appear to lie not deeper than one or two inches beneath the surface of the wood. It is possible, however, that they may not issue until next year, and for this reason I hesitate to have the tree cut down. The fibres of the wood are still moist and very light in color, showing very slight fermentation except where the

juvenile galleries of a year or two ago have penetrated. There are no young larvae, and evidently all are of the same age and nearly or quite adult, and there are no exit holes in the tree. There may be 50 to 100 larvae in the trunk, but of course this is only a surmise.

"I feel quite certain now that there are comparatively few broods of Dinapate existing in this region, and unless it exists also in Baja California or on the southern slope of the San Bernardino range, any year may witness its complete extinction; because unless the females, in imago, feed upon and kill the buds of living palms in which they then oviposit, the number of trees in fit condition to rear the young is exceedingly limited. I have in fact seen but this one tree in any of the canyons I have visited. It is absolutely certain that only the Washingtonia palm is capable of supporting the large broods of this gigantic borer, and if the females should fail to find a suitable tree in any year, they must inevitably perish without issue. When I consider the limited number of these trees in existence in a wild state, and the slender chance the female beetle must have of finding a dying tree in the right condition and at the right time, I am more than ever inclined to suspect that the beetles deliberately kill the tree in which they oviposit. If they killed the tree merely by feeding as adults upon the buds, there would be many trees killed; for often more than 200 adults issue from a single infested trunk. In the case of the tree I have examined, it is probably not the presence of the larvae that have killed it as they have not apparently penetrated deeply into the interior and their galleries are not sufficiently numerous to seriously impede the circulation of the sap, even in the outer portion of the trunk."

In March, 1897, Mr. Hubbard added several interesting details:

"On March 5 I made a serious expedition with a wagon and mules and an Indian guide to help, to Palm canyon, where I spent the day getting out more pieces of palm wood containing Dinapate larvae. I secured four pieces weighing each from 2 or 3 to 6 or 8 lbs., and each containing one or two living larvae. The largest piece undoubtedly contains several of the larvae. These pieces I now have in my bedroom and I can occasionally hear the larvae cutting the fibre with a snap like a pair of shears.

"I discovered, much to my surprise, that the interior of the palm trunk is entirely filled with galleries. I had before concluded that all the work had been done nearer the surface, the trunk being an extra thick one. I find, however, that this trunk, like all the rest, has the interior entirely riddled with burrows and very little solid wood left by the larvae. Many of the larvae are still in the interior, although some of them are already forming cells near the exterior. We cut into a great many of the grubs in getting out these chunks of wood, and I secured several good additional specimens in alcohol.

"It is hard to realize the enormous extent and dimensions of the Dinapate galleries. Not the largest of our Florida palmettos could support more than three or four of these larvae; they would eat it all up and then die of starvation. If there are 20 or 30 holes in one of the Washingtonia palms, one finds the interior entirely eaten out from end to end, and one can follow the galleries, over one inch in diameter, for 20 feet up and down the trunk following the grain and without diminishing sensibly in diameter. Then think of the yards and yards of smaller galleries made by the larva while still young. Such extensive and prodigious borings cannot be made in one or two years, and certainly not in any tree trunk of moderate size. There is certainly no other plant here than this Washingtonia palm that is capable of supporting a brood of these huge

and voracious grubs. Therefore, I do not hesitate to assert that they exist only in the Washingtonia, and that they are very certain soon to become extinct. I regard the discovery of a colony as one of the most interesting entomological events of my life and I can assure you that if we breed the imagos this year from this trunk, they will not soon be duplicated by others.

"There are some thousands of the trees left, but they are in small groups scattered miles apart in a few of the most inaccessible canyons of the San Jacinto range. Here the beetles are nearly extinct, but it is possible that in Baja California they may survive a few centuries longer. In times past they were abundant here, as evidenced by the numerous old trunks riddled with their burrows. But the trunks that have fallen in recent years are all free from their attacks, and as the Indians have burned all the trees that are accessible, so that their trunks are now bare of fronds, it must be now quite difficult for the female beetle to find a fit receptacle for her eggs. I am sure now that they do not oviposit in bare trunks or in healthy trees, although it is possible that the beetles kill the tree in which they oviposit their eggs."

A letter written by Hubbard to Dr. Murray of Palm Springs has been placed in my hand through the courtesy of Dr. Fenyes. This gives directions for securing specimens and is worthy of publication.

UNITED STATES DEPARTMENT OF AGRICULTURE

DIVISION OF ENTOMOLOGY, WASHINGTON, D. C.

March 26th, Palm Springs.

Dinapate wrightii—A tree containing numerous larvae stands back on the side of Palm Canyon, on the right hand side of the stream, up against the rocks in the first wide park just around the first bend. This tree is probably 14 or 15 feet high, feathered with fans but the bud is dead. The entire trunk is full of larvae except perhaps the lower two feet. In March, this year, the larvae were working to the outside and many of them were forming their pupating chambers, very near the outside. I think the perfect beetles will issue before the middle of July and therefore I will recommend that sometime late in June the trunk be cut down and brought in to Palm Springs and housed in a good tight room with light and sufficient air, so that it will not ferment and mould. When the mature beetles are obtained they should be killed by immersing them in hot water (not actually boiling) for a few seconds or not long enough to boil them. After being thoroughly drained of adhering drops of water they may be packed in any convenient box between layers of soft paper to separate the specimens and prevent their decay and disintegration when massed together. It will be best to pack only a few specimens together in small match boxes and when these have been dried any number of the boxes may be packed in a larger box. No tin box should be used for packing large insects as it confines the air and promotes mold and decay of the ligaments so that the legs and members drop away and the specimens are spoiled. When the beetles are dry they cannot be disturbed without breakage, therefore they should be packed while fresh and not too many together. I will pay $1.00 for each specimen of the mature beetle in perfect condition, up to $100.00 for 100 specimens, and will accept a larger number if obtained, but the price per specimen of the second hundred will not exceed 50 c. In case of failure to obtain the beetles I will bear my share of any expense incurred within reasonable bounds.

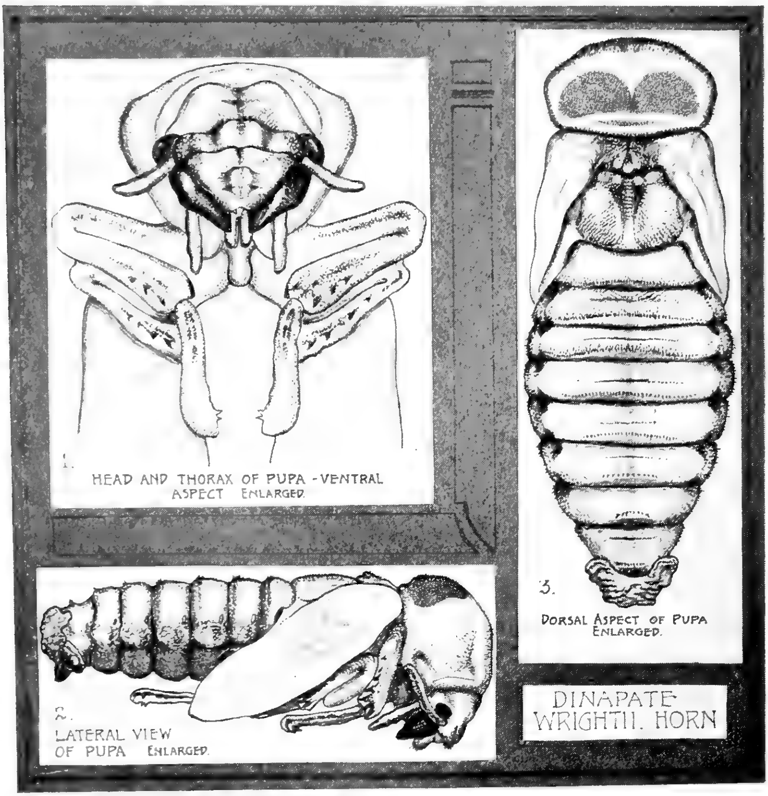
Communications may be addressed to me at 230 New Jersey Avenue, Washington, D. C., which is my private address in that city and the specimens of *Dinapate* may be sent to me there and in my absence will be received and cared for by my representative and colleague, Mr. E. A. Schwarz.

(Signed) HENRY G. HUBBARD.

(Detroit Address: 101 Griswold St.)
DR. WELWOOD MURRAY,
Palm Springs, Cal.
March 26th, 1897.

In 1917 Mr. J. O. Martin contributed an article to the Bulletin of the Brooklyn Entomological Society (Vol. XII, p. 107) in which he brought out certain additional facts. We quote a portion of his contribution.

PLATE B.



He mentions searching Andreas and Murray canyons where no dead palms were obtainable, and then goes on to say:

"Finally I returned to Palm canyon and examined all of the bare fallen trunks of which I had noted several in my previous search. It is not an easy matter to chop into one of these palm trunks even when they have been dead for years, but I worked two days at it without success and was about to despair when a stroke of my axe turned out a larva about three-fourths of an inch in length which I thought might be that of Dinapate. By placing my ear against the log and keeping very still I could hear others gnawing away inside with a click like that produced by snapping the nails of the thumb and first finger together. However, it was clear that if this was the larva of Dinapate it must grow at least a year before it would be as large as that described by Horn, so I decided to wait until the following spring before carrying out the plan which I had in mind.

"This last spring (1917), I again went to Palm canyon, sawed out of the prostrate trunk four two and a half foot lengths, taking them where the gnawing sounded most frequent, and packed them out to my automobile, a distance of about two miles. Another section of this log was later obtained by Mr. J. R. Campbell of the U. S. Bureau of Entomology. A week's further search of the various groups of palms failed to show any other possible host tree. In sawing the log into transportable lengths the saw disclosed several larvae in the various cuts, two of which it bisected. The ones which were uncovered but not cut soon bored their way into the log and out of sight. However, I was much surprised to find that there were evidently two separate broods of larvae in the log, one apparently full grown and ready to pupate as shown by the presence of one pupa, the others about three-fourths of an inch long. I am convinced that the larvae seen last year are the ones full grown and the smaller specimens represent a brood deposited since the discovery of the log.

"This log when discovered was full of sap and showed every evidence of having been torn up by the winter flood which this year was the heaviest in over forty years. There were no leaves attached and its size showed it to be one of the older trees, the leaves of which were burned off by the Indians.

"On getting my ten feet of log home I at once constructed two stout cages for their reception and then came a long wait. Every morning on arising since March, when the sections of the log were brought home, my first duty has been to inspect the cages. Not until August third was there any change and my long watch was rewarded by my first sight of a living Dinapate. A fine pair, lady and gent, had emerged during the night and were vainly trying to conceal their huge bulks ostrich-wise by shoving their heads into any dark corner. Since then until the present date, September 17, thirty-one of these beetles have emerged, generally one at a time, but one morning there were four and several times two came together. At first the sexes were quite evenly represented, but during the last two weeks only females have emerged.

"All of these emergencies took place after dark, in the early part of the night, not later than 9 p. m. Several times I tried to see the beetles come out by the aid of a lantern, but the presence of a light caused

them to cease operations at once. One evening, however, I was able to watch this process by setting the lantern four feet away: the light was dim but sufficient for observation by close attention. When first discovered this beetle had cut through the outer surface and had made a hole about one-fourth inch in diameter. This hole he continued to enlarge with his powerful mandibles turning continuously from right to left as he bit away at the circumference.

"After about half an hour of this circular gnawing he tried the hole, starting out venter down, but as he could not get his thorax through he retreated and took several bites, evidently with an exact knowledge of the spots that bound.

"He then tried his work and finding it to his liking backed in again and after a short rest turned belly up and came out headed up the log, which he at once ascended to the top. On coming out these beetles are hardened and fully colored and had evidently spent some time in the pupal chamber in the adult condition.

"They at once began trying to fly and spent their strength against the wire netting of the cage, the sexes paying no attention to each other, from which I surmise that they seek mates from some other brood. When daylight comes they try to hide, putting their head into any dark corner, where they remain all day without motion.

"The males and females are easy to distinguish by the characters given in Horn's description, but I note a further sexual character in the granulation of the elytra: in the males the lateral margin and the tip behind the tubercles is smooth, while in the females this area is distinctly granulated. Also a slight difference in the shape of the thorax, that of the males being broader. The males also have a more shining black appearance than the females.

"I have now thirty-six specimens of Dinapate wrightii, fourteen males and twenty-two females. I can still hear the second brood at work and hope to have more emerge next year."

In 1918 Mr. Richard T. Garnett added to our knowledge of this remarkable beetle, in an article published in the Entomological News. (1918, p. 41).

He writes:

"This extremely rare Bostrichid, called by Hubbard the "dodo" of Coleoptera, was taken by the writer in Palm canyon on May 21 and 22, 1917. Every dead or unhealthy specimen of the palm, Washingtonia filifera, in Palm, Murray, and Andreas canyons, was thoroughly examined. Of these only one log in the extreme lower end of Palm canyon contained the beetle. This log, covered by driftwood, was wedged into a crevice in the rock strata fifteen feet above the summer stream level. From this log on the days mentioned 133 adults, 28 pupae and 17 larvae were taken. Of the adults 81 were males and 52 females. When the log was discovered, one adult had made its exit, as was shown by the freshly bored exit hole. The colony therefore totaled 179.

"Many other logs in these three canyons had exit holes in them, but with the exception of the one above noted all were black with years of weathering. The average number of exit holes, making a count of 20 trunks, was 14, the highest number being 21 and the lowest 2. A great many must perish and decay in their pupal cells if the colonies average anywhere nearly as many as the one which I found.

"A few of the adults were yet soft from their change from the pupae, but the majority were hard and would undoubtedly have emerged in 1-14 days. Thus, if there are any survivors of this species, the time of emergence must be the latter part of June or the first part of July.

"The galleries of the fully grown larvae averaged 18^{mm}. in diameter. This diameter was exceptionally constant for larvae of the curled type. The galleries crossed and recrossed each other in a confused manner, practically destroying all fibre in the region attacked, the powdered material being packed extremely compactly. The galleries never approached closer than an inch to the hard outer layer of the trunk and the very center of the log for six inches in diameter was untouched. All the wood in between was completely riddled by the borings. The larvae were working usually at a depth of about 3 to 7 inches beneath the surface. Although the position of the log may have had something to do with it, almost all of the pupal chambers were either parallel to the surface of the log or nearly so. The exit holes were being bored almost perpendicularly from the pupal chamber to the outside.

"Two of the larvae were of a much smaller size than the rest, thus tending to show that the life cycle is at least two years' duration.

"The weakening of the trunk by the galleries often causes the trees to fall, 19 logs occurring in Palm canyon alone. A great many of the standing trees have exits visible on them, but usually only two or three per tree, most of them situated within ten or twelve feet of the ground, although a few were noted near the tree crown. When occurring in prostrate logs, the exit holes seemed to be indiscriminately dispersed.

"The attacks of this beetle are not always fatal, as is shown by a number of standing and perfectly healthy trees with exit holes in their boles. If these holes are numerous the tree is generally dead."

"In the larval, and possibly the pupal, stages this insect must be very resistant to water, as the log had apparently broken off at the roots during the winter of 1916, been carried down the canyon and jammed into the crevice by the high water. In this journey down the stream the water must have seeped into the interior of the log. A live larva was placed in water and was drowned in 28 minutes. This, however, is a more severe test of vitality than the water-soaked log was. A live adult was drowned in 15 minutes 35 seconds. Three hours in a strong cyanide bottle was insufficient to kill three of the adults.

"LARVA.—Robust, ventrally flat, dorsally convex; yellowish white, mandibles black; 8 abdominal segments, 3 thoracic; clypeus white, labrum darker and on anterior two-thirds densely, finely ciliate; labium and maxillae white with a line along their base chitinized; antennae 3-jointed, bisetose at tip. Body covered with short fine silky hair; body resembles that of a "white grub" being curled, however, the anterior segments are much the larger. Legs apparently 3-jointed (Horn says with 4 articulations) tarsal claw one and cleft. Length $46/63^{mm}$. (All measurements following are from the anterior margin of the thorax to the tip of elytra.)

"PUPA.—Resembles the adult, white; head, thorax, and elytra smooth, the latter bent under the abdomen between the middle and hind pair of legs; the most prominent costae and tubercles usually visible on the elytra; dorsal surface of the meso and meta-thorax and of the abdomen visible; scutellum prominent; a row of fine recurved teeth across the dorsal side of each abdominal segment except the last, each row situated nearer to the posterior edge of the segment than to the anterior and on an elevated ridge; abdomen 9-segmented; on the end of the abdomen is attached the shriveled larval skin, the mandibles on the ventral side. Length $42/64$ ^{mm}., width $15/20$ ^{mm}.

"ADULT—Cylindrical, shining black; head concealed from above by the thorax; antennae 10-jointed, first joint elongated and stout, over twice as long as the second joint which is also stout; joints 3 to 7 smaller and equal; joints 8 to 10 much wider and clavate, 8 and 9 triangular, 10 more rounded. Eyes large, prominent. Labrum distinct, anteriorly ciliate with silky brown hair.

"Thorax very convex, sparsely clothed laterally with short brown hair; middle of anterior portion without the distinct bulge shown in Horn's figure of adult female; posterior half granulate with a median longitudinal sulcus smooth; anterior half with recurved dentate tubercles (teeth less pronounced in the females), the extreme anterior edge granular only.

"Elytra shining, glabrous; costae 4, the 2 outer indistinct; intervals of inner 2 costae foveolate, smoother towards sides; the 2 inner costae terminates in a tubercle (female), and in a robust tooth (male). Elytra bent downward behind the upper tubercle at an angle of 45–60 degrees. The declivity smooth in the male, granulate in the female.

"Abdomen 5-segmented, all segments equal and fully visible; entire ventral surface covered with fine silky brown pile.

"Legs more or less covered with hair, front coxae prominent, conical, trochanters prominent, femora stout, tibiae flat and acutely dentate externally, tarsi 5-jointed, claws simple and arcuate, 5th tarsal joint with a bristle-bearing pad."

"Length 38–51^{mm}; width 14–18^{mm}.

"The adult is lumbering in its movements and has poor eyesight as one of the beetles escaped and while in flight collided with anything that came in its path, making its recapture easy. Although the wings are well developed, the heavy body impedes swift and unerring flight."

To sum up the essential known facts concerning the life, history and habits of this beetle:

The eggs are laid preferably at the bases of the leaf stems, on trees that are sickly. Live trees are, however, occasionally chosen as are also dead and even prostrate ones. The female chooses for ovipositing some point where the newly-hatched larva will not have to perforate the hard trunk.

No description of the egg has been given. The larvae take two seasons for complete development, emerging during the second summer, the favored month being July. Some may emerge in June and delayed specimens occasionally hold over until the last of August.

The larvae feed on the pith of the palm, boring their way through every portion of the tree trunk except the hard outer bark.

They can be heard at work, cutting the fibres with their stout mandibles. Their tunnels are completely filled behind them, as they burrow, with sawdust and frass.

As they approach the pupal stage the larvae work towards the outer bark, where their pupal chamber is formed at a depth of one-half to one inch from the surface.

The number of moults of the larva has not been recorded. I have observed one such casting in a partly grown larva. This occurred on August 17th, the specimen having remained dormant for three days. It was at this time one and three-quarters inches in total length, dorsal measurement. The skin was split in much the same manner as is common to most beetle larva. All parts of

the larva were a pure white, following this moult. On the 18th, it was noted that the mouth parts had changed to a yellow, and the following day they had assumed their brownish black hue. Late on the 19th, burrowing had recommenced.

The pupal chamber is made parallel to the bark, and is entirely free of sawdust. From this chamber the beetles cut a round hole for emergence at right angles to the long axis of the chamber. They emerge at night, and are thereafter nocturnal in their habits.

When the final skin is cast, and the pupa emerges, this cast-off garment remains as a rumpled pedicle, loosely adherent to the caudel segment.

I present on Plate A several drawings of the larva of this beetle, made from live specimens. On Plate B are also shown three aspects of the pupa. The latter are presented in sufficient detail to obviate the necessity of a technical description. Figure II on this plate is foreshortened one abdominal segment. With this exception the drawings are in proper proportion and accurate as to structure and detail.

The species has been recorded, thus far, only from Palm canyon, San Andreas canyon and Murray canyon, which are all a few miles from the town of Palm Springs, in the Coachella Valley, California. It is rather strange that this beetle has not gained a foothold in our Southern California towns and cities where the fan-palm is much in evidence. Perhaps a careful search by horticulturists for the round exit holes may disclose its presence.

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BUTTERFLIES OF CALIFORNIA

By Dr. John A. Comstock

We are publishing with this issue of the Bulletin, Plate III of the series of illustrations of California butterflies. The text describing these illustrations appeared in the April, 1921, issue (Vol. XX, Part I). This completes our series of the Papilios or Swallowtails. The illustrations include all species that are commonly met with in the state. Some authors have included in their California lists, a very common Eastern species, as an introduced form. This is the *Common Eastern Swallowtail* (Papilio asterias, Fabr.) It is doubtful if this species has attained much of a foothold in California. If taken at all, it will be found in close proximity to vegetable gardens where parsley or parsnips are grown. Several collectors have confused it with our mountain species, Baird's Swallowtail, which it closely resembles. It is however a somewhat smaller species, and in the male sex may be distinguished by the slightly narrower yellow band of spots traversing the discal portion (middle area) of the wings. It has seemed hardly necessary to picture this common species, as cuts of it occur in practically all works on American butterflies.

PLATE C.

Strymon Cuyamaca
♂ Type, Upperside

PLATE D.

Strymon Cuyamaca
♂ Type, Underside

A NEW LYCAENID
(Lepidoptera)

By W. S. Wright

Miltoura spinetorum cuyamaca new sub-species.

Through the kindness of Dr. John Comstock of the Southwest Museum I have before me four specimens of *Spinetorum* Boisduval and two paratypes of what I believe to be a new sub-species. I have also before me Oberthur's figure of Boisduval's type. Not having Boisduval's notes I am unable to determine the published range of his species.

Of the four specimens of *spinetorum* mentioned 2 are from Priest River, Idaho (Herr), and 2 are from Morris Canon, Cochise County, Ariz. (Owen). One of the Priest River specimens is typical except that the submarginal line of spots is complete on secondaries, the other has slight variations in the line on the primaries beneath, it is bent on the subcostal, and extends in a deep inward curve from vein 2 to inner margin. Both the Arizona specimens show the extended line on the primaries and in one of them the W-mark on the secondaries is obsolete while a white discal dot appears on the primaries beneath. It will be seen by this record that the range of *spinetorum* is extended and although the localities given are widely separated there is no good reason why it might not be taken at intermediate points as well, probably always at high altitudes.

The new sub-species which I shall call *cuyamaca* would also seem to have a wide range: from San Diego County on the south to Martina, Montana, on the north, with one specimen from an intermediate point—Sierra Madre Range near Los Angeles, Calif. Cuyamaca may be characterized as follows:

Expanse, 32 to 34^{mm}.

Palpi, gray with black tips. Front, dark brown with 2 pure white lines from base of antennae to base of palpi. Antennae, dark brown, annulate with white, fulvous at tip.

Upper surface: Stigma rather indistinct. Color, dark brown with a massing of dark blue scales on basal half of primaries and entire surface of secondaries except along inner margin and at apex. In *spinetorum* the blue scales are confined to basal area on both wings. Fringe on primaries white at tip. On secondaries the fringe is white from apex to tail with a black spot at vein three, black beyond tail to anal angle with a white spot at vein one. In *spinetorum* there is a very short tail-like projection of the fringe at vein 3 and no white spot at vein 1. Tail black with a white tip.

Under surface: Entire under surface of both wings evenly covered with fulvous scales. Primaries with white discal dot, absent in *spinetorum*. Half way between dot and margin is a brown line outwardly edged with white and nearly perpendicular from costa to vein 3 which it crosses with a slight sweep inwardly ending abruptly at vein 2. It will be noted that in *spinetorum* this line is distinctly bent at vein 3 and lies much nearer the margin at that point.

On the secondaries the line is a darker brown and similarly edged with white on the outer side. It commences about two-thirds out from the base, makes a long sweep with slight inward curve to a point on vein 3 a little more than two- thirds out. This part of the line forms the outer limb of a sharply angled W-mark with the inner limb ending just beyond vein 2. From the upper end of this inner limb the line extends to about the middle of the inner margin in a broad, shallow, rounded "V." In *spinetorum* this line is straight from the origin of vein 4 where it forms a distinct angle with the outer limb of the W-mark. The line forming the V-mark is joined to the W-mark by a broadly rounded angle while in *cuyamaca* the juncture is a sharp angle. There is a sub-marginal line of black spots, the largest of which is between veins 3 and 4, edged on inner and outer sides with a few white scales. A patch of bluish scales between the spot and the margin. A second spot, much smaller than the last, lies between veins 4 and 5. Between vein 3 and the inner margin are three narrow black spots or dashes with bright fulvous scales outwardly. On the margin between veins 2 and 1 is a large black spot with a few bluish scales outwardly and between it and the anal angle is a large squarish patch of bluish scales. A black spot at anal angle. A fine white terminal line. Base of fringe black, tips white. In *spinetorum* the sub-marginal line of black spots is reduced to a single large spot between veins 2 and 3. The fulvous scales form a distinct scalloped line edged inwardly with dark brown. No trace of blue scales appears and there is no white in the fringes.

Thorax below, mouse colored; legs dark brown or black, and white.

Allotype male, Cuyamaca Lake, San Diego County, Calif., July 7, '18. (Unfortunately the photographer in handling the type broke off the antennae and abdomen and lost them, but not until he had succeeded in making a plate).

Holotype female, Julian, San Diego County, Calif., Aug. 4, '17.

Paratypes, 3 males Julian, San Diego County, Calif., Aug. 4, '17, numbered 1, 2, 3; one male, No. 4, Sierra Madre Range, Los Angeles County, Calif., July 5, '20, and one male, Martina, Montana, no date. No. 5.

The types and paratypes 1-3 are in the author's collection. Paratypes 4 and 5 are in the Southwest Museum collection.

THE TRUSTWORTHINESS OF THERMOMETERS USED BY CALIFORNIA FRUIT GROWERS

By Dr. Ford A. Carpenter, Consulting Meteorologist

(Illustrated by the Author)

"Are your temperature readings accurate?" is one of the questions being asked with increasing frequency in California. It may be answered in the affirmative, if (1) the thermometer has been properly made or tested, (2) if it has been properly located, (3) if it has been correctly read, and (4) if the readings have been promptly recorded.

It is the purpose of this paper to present some of the difficulties encountered in the manufacture of thermometers; to describe some of the methods used in their calibration; to show how they may be placed in localities giving the best results; to explain how personal errors may be avoided; suggest the making of satisfactory records; to enumerate the results of a year's tests of various types of thermometers and summarize the relative accuracy of the different types in use by orchardists and others.

THE NECESSITY OF A THERMOMETER TESTING BUREAU

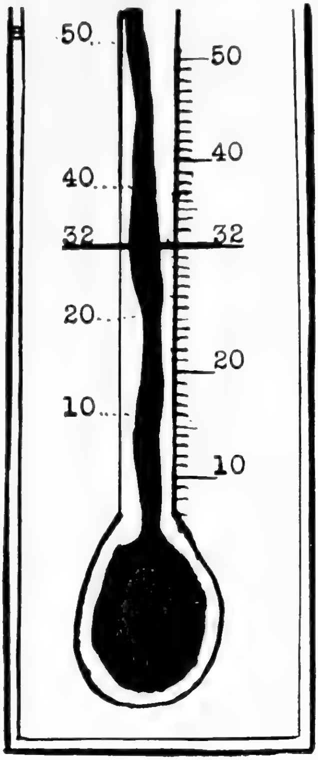
It is an unsolved problem whether credulity or incredulity is responsible for the greater amount of error. In the matter of thermometers ordinarily in use there appears to be no doubt at all about the solution: it may be said without hesitation that it is the former, for not one person in a hundred but what believes that the thermometer is reliable. This is not only true of the processes of taking temperature readings in the citrus orchards of California or elsewhere, but the same criticism holds good in the use of clinical thermometers and thermometers when applied in the arts and in the industries. Human nature is apt to accept a printed statement, or an engraved or stamped scale as being correct without personal investigation. And is it not natural? We never think of checking up the accuracy of a foot-rule or a yardstick; it is accepted as being dependable. If the making of thermometers was simply a matter as dividing off the tenths or sixteenths of an inch on a wooden or metal strip, most of the difficulties in the use of a thermometer would be solved.

When the practical research department, dealing with meteorology applied to agriculture and aeronautics, was created in the Los Angeles Chamber of Commerce as described in a Bulletin of this Society*, one of the objects set forth was the standardization of certain instruments used in industry. A few tests were convincing proof that one of the most important fields for investigation was the examination and certification of thermometers used by the citrus growers of Southern California, so, in November, 1920, a testing bureau was established.

*Bull. So. Cal. Acad. Sci., Vol. 19, Pp. 9-11.

WHY THERMOMETERS ARE GENERALLY INACCURATE

The problem of accuracy in thermometers was then stated by the writer† as follows:



True Temperatures (Corrected temperatures) | Incorrect Temperatures (Thermometer scale)

Fig. 1—Exaggerated Thermometer Tube—If an ordinary thermometer tube could be magnified, the irregularities of the bore would look something like this. The maker stamped graduations on the scale regardless of the diminishing or increasing size of the inside of the tube. This resulted in the thermometer being 3° too low at 40°, and 4° too high at 20 degrees.
(Courtesy, California Citrograph)

"There are three reasons why a thermometer is inaccurate when it ordinarily leaves the maker's hands. (First), improper seasoning of the glass of the thermometer tube, (Second), freezing-point of thermometer not determined, and (Third), thermometer not calibrated.

"First, the thermometer tubes may not have been sufficiently seasoned. Glass, like wood, has to be freed from shrinkage. If unseasoned glass is used, the bore will contract with age and the thermometer will read high.

"Second, the thermometer may not have been tested at the freezing-point. Not one thermometer in a dozen is ever tested except at the freezing point and few such instruments are ever tested at all. In the poorer grade of instruments, once this 32-degree mark has been found, the tube is fastened to the metal back and the thermometer is placed on sale.

"Third, the inequalities in the diameter of the bore may not have been determined. From the nature of the glass-blowing operation, the bore of a thermometer-tube has many and often considerable irregularities, necessitating careful calibration. Even the best of thermometers possess these errors in the diameter of the tube. To obviate these inherent characteristics, the following method of graduation is resorted to in making a standard thermometer: A carefully annealed glass tube is selected and a small thread of mercury, five degrees in length, is inserted in the tube and this is pushed along the length of the bore and the graduations marked on the tube itself with a diamond. Afterwards the thermometer is tested in comparison with a known standard and the temperatures at 32 degrees and other definite heights are marked. To complete the operation, in case the instrument is to be used for purposes requiring great accuracy, as in testing other thermometers, the thermometer is further compared with a standard and corrections noted, whenever necessary, for every degree throughout the length of the tube.

†Cal. Citrograph, Vol. 6, Pp. 3-38.

"If an ordinary thermometer tube could be magnified, the irregularities of the bore would look something like the varying diameter of the temperature column in Fig. 1. On the right side of the tube there will be noticed the ordinary scale readings, 10 degrees to 50 degrees, with the freezing point indicated. On the left of the tube have been noted the real temperatures—not the heights of the mercury column. The thermometer is assumed to be correct at 32 degrees, but owing to the increasing and diminishing size of the inside of the tube, the true temperature is 16 degrees when the thermometer shows '20 degrees,' 20 degrees when it shows '24 degrees,' 40 degrees when the mercury stands at '37 degrees,' etc. There are some instances where so-called 'reliable' thermometers showed a divergence of 4 degrees and even 6 degrees from the correct temperature."

The problem was rendered more difficult by the inaccuracy of instruments of all kinds manufactured since the World War. It is the common experience of all persons desiring dependable instruments to seek pre-war construction, but where skilled manufacture was not in evidence, recourse had to be made to the matter of careful tests of the available stock.

NINETY PER CENT OF ORCHARD TEMPERATURES ARE INCORRECT

The result of a year's tests of thermometers, which were brought to the testing department by over one hundred fruit growers, gave interesting figures. It was found that 43% of the thermometers read too high, 45% read too low, 6% were structurally out of order, and only 6% were accurate. (See Fig. No. 2). The two hundred and ten thermometers that were submitted for test by the orchardists during the year were not the ordinary kind, but instruments bearing names of well-known makers and cost their owners on an average of $5 each. One fruit-grower* reported "Ninety per cent of the thermometers we were using were incorrect and after having same tested and marked, we were able to save

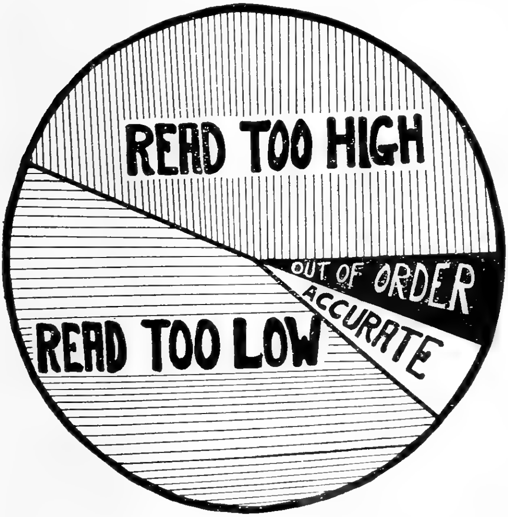


Fig. 2—These diagrams show the relative accuracy of a large number of thermometers which the fruit growers of California submitted to the testing bureau of the department of meteorology and aeronautics of the Los Angeles Chamber of Commerce during the season of 1920-21. The circle shows that 43% of the thermometers submitted for test read too high; 45% read too low; 6% were out of order and 6% were found to be accurate.

*Cal. Citrograph, Vol. 7, Pp. 72-78.

several thousand dollars. I believe that citrus growers of California have wasted thousands of gallons of oil in smudging for frost protection by having incorrect thermometers."

WHY ONE TYPE OF THERMOMETER IS BETTER THAN OTHERS

There are three general types of thermometers in use in the orchards for frost protection: The U-tube (Sixe pattern), the ordinary stem thermometer, and the horizontal or minimum thermometer. The first-named were notably inaccurate, only 1% were found to be without error and nearly one-third were thrown out as being dangerously inaccurate. The ordinary kind of thermometer fared only a little better; only 2% being reliable. Of the horizontal variety, 32% were dependable and 3% were sufficiently erroneous as to be classed as dangerous.

For over thirty years the governmental meteorological services of this and other countries have adopted a standard maximum and a standard minimum recording thermometer. This instrument, being somewhat more difficult to make than other types, probably caused the manufacturers to advertise and sell the other simpler varieties without regard to accuracy. The commonest kind of thermometer used in the orchards of Southern California is the U-tube model designed half a century or more ago by Sixe of London. Where errors of 3 to 6 degrees are inconsequential, this thermometer may serve, but for use in situations where half a degree may determine the danger point, such instruments invariably invite disaster. It is unfortunately true that the consumer must *demand* accuracy or practically worthless instruments will be sold him. It would appear that manufacturers would suit their products to the situation and distribute instruments applicable to the region rather than to continue supplying inferior equipment. Since the findings of the testing bureau have been made public, it is significant that the grade of thermometers supplied this market by the manufacturers has greatly improved. It is not uncommon for an order to be placed with the proviso that "the instruments must receive certification from the testing bureau before acceptance."

The following chart shows in graphic form the relative dependability to be placed on the different types of thermometers:

The net result of these tests has been to gradually eliminate inaccurate thermometers from the local markets for the simple reason that the consumers, realizing that price or brand did not make for accuracy, demanded that their instruments measure up to a standard set by the testing bureau. Fruit growers in possession of tested thermometers used them in the comparison of many other instruments and thus automatically did away with misleading thermometers.

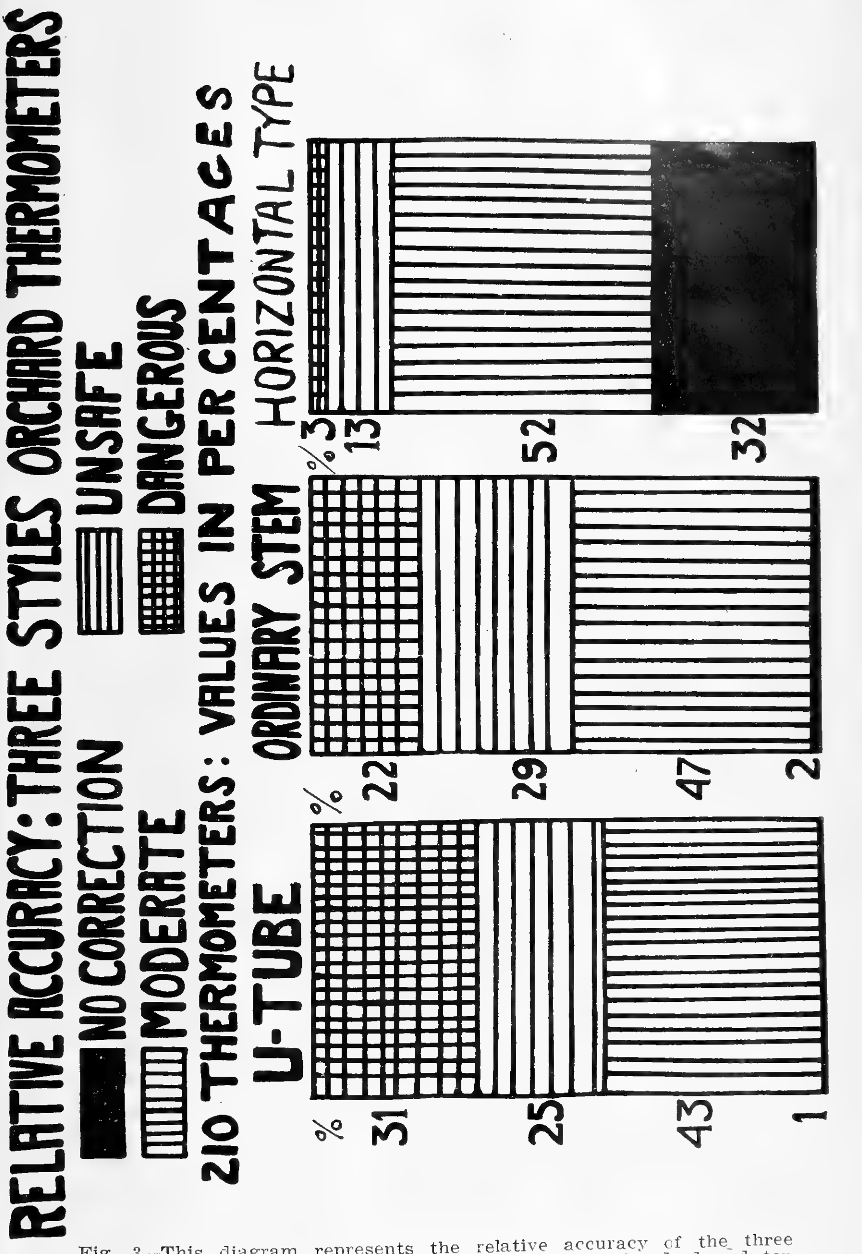


Fig. 3—This diagram represents the relative accuracy of the three principal types of thermometers in general use. Two hundred and ten thermometers were tested; 124 of the U-tube pattern, 55 of the ordinary stem variety, and 31 of the horizontal self-recording style. Only 1% of the U-tube pattern, 2% of the ordinary straight stem, and 32% of the horizontal model were found to be accurate.

THE NECESSITY OF SHADING OR SCREENING OF THERMOMETERS

The exposure of a thermometer is most important, second only to the original accuracy of the instrument. As the object sought is the *temperature of the air*, the thermometer should be exposed to air currents (not that wind affects temperature *per se*—for it cannot if the bulb of the thermometer be kept free from dust) and yet shaded from the sun's rays. Wherever possible, thermometers for orchards should be given the standard Weather Bureau exposure, *i.e.,* in a suitably made instrument shelter screened from the sun, double-roofed and open only to the north. The necessity for protecting thermometers from the sun in order to obtain the true temperature of the air was shown during a South Pole expedition. Commenting on this, Dr. Griffiths Taylor, the Australian meteorologist, stated:†

> "If we expose the thermometer to the sun, we do not obtain the *air* temperature by any means. For instance, 154°F. is undoubtedly hot, yet this was recorded in Antarctica in 1902! But the true *free-air* temperature at this locality was 24°, or *eight degrees below freezing!*"

In other words, the difference between the reading of the thermometer in the sun and in the shade was one hundred and thirty degrees.

The size of the shelter for the thermometer is immaterial, provided it is not too large. It is important, however, that the shelter be made of thin wood and painted *white*. The thermometer should be located, if in an orchard, in that portion giving average condition, not too close to a tree, free from the influence of a dwelling, and also distant from the relatively warm air emanating from an irrigation standpipe or ditch. These are some of the ideal conditions under which dependable temperatures may be secured.

OBSERVATION OF TEMPERATURES IN THE ORCHARD

The personal equation in reading thermometers cannot be overlooked. Observers should cultivate the habit of reading to tenths of degrees. This is not difficult, for it is only a matter of training the eye to estimate. Milham* summarized what he aptly terms "temperature blunders" as follows:

> "There are four avoidable blunders: (1) A good thermometer must be used in determining the temperature. It is a waste of time to attempt to make accurate determination of the temperature with an inferior instrument. (2) The error of parallax must be avoided . . . The correct position of the eye is such that the line of vision is at right angles to the stem of the thermometer. (3) The observer must

†Taylor, Australian Meteorology; 1920, P. 27.
*Milham, Meteorology, 1912; Pp. 65-66.

avoid heating the thermometer by the presence of his own body. (4) A thermometer must be given time to indicate a new temperature."

TEMPERATURES SHOULD BE PLOTTED

To secure best results, orchardists and others using thermometer readings should enter them on contour maps of their plantings. One of the first things that will become apparent will be that contours of elevation and lines of equal temperatures do not always coincide. Higher ground does not always indicate a warmer region, nor do lower levels correspond with decreased temperatures. The drainage of the air, the drift of surface currents, the orientation of the locality to the sun's rays, and the character of the immediate environment, all contribute to the varying temperatures encountered over a comparatively restricted locality. Temperature controls can only be studied and definitely determined by the use of accurate thermometers properly placed and carefully observed.

NEW BOTANICAL RECORDS FOR SOUTHERN CALIFORNIA

Anstruther Davidson, M. D.

Lianthus filipes Benth. *Gnaphalium beneolens* Davidson; and *Boschniakia strobilacea* Gray, the latter in great abundance under the manzanita bushes, were collected by Mr. R. Kessler on Mt. San Jacinto.

Mr. L. Shick collected at Barton Flats, *Psoralea rigida* Parish, hitherto only reported from San Diego County, and *Anaphalis margaritacea* L. This is a rather unusual place to find the latter as it is supposed to be an introduced species. *Quercus Morehus* Kell., a few trees of this species were discovered near Seven Oaks by Mr. Joseph Anthony.

EUMENES PACHYGASTER

ANSTRUTHER DAVIDSON, M. D.

This wasp is peculiar to California and their nests are probably rare as only once have I collected them in the neighborhood of Los Angeles. The accompanying illustration is that of a specimen discovered by Theodore Payne near Santa Barbara. The neat urn-like nests so closely resemble the olla of the Indians that it may well have served them for the original model. From two of the cells there hatched out the parasitic fly *Senotainia trilineata* V. d. W. For the identification of the wasp and parasite I am indebted to Dr. L. O. Howard, U. S. Department of Agriculture.

TRANSCRIPT OF MINUTES OF THE MEETINGS OF THE BOARD OF DIRECTORS,

Southern California Academy of Sciences

JULY, 1921, TO DECEMBER, 1921

DIRECTORS' MEETING

July 13, 1921.

A special meeting of the Directors of the Southern California Academy of Sciences was held in Room 805, I. N. Van Nuys Building, on the date above given, having been called by the Treasurer.

General discussion was held on matters pertaining to the good of the Academy.

The suggestion was voiced that a list of the publications of the Academy be run in the "Bulletin" with attached prices for such issues as were available. The Secretary was instructed to prepare and submit such a list.

Mr. Keese placed before the Board a proposal that the L. A. County Museum and the Southwest Museum lend co-operation and support in the matter of publishing the Academy "Bulletin," and asked an expression of opinion from the officials of the two institutions.

Dr. Bryan, on behalf of the County Museum, voiced general approval of the idea, but stated that available material for publication might not be immediately forthcoming.

Dr. Comstock, speaking for the Southwest Museum, pledged material for publication from the research department of that institution. After some further discussion the meeting adjourned.

Members present: Dr. Frank Clark (presiding, Mr. Keese, Mr. Spalding, Mr. Beebe, Mr. Geo. Parsons, Dr. A. Davidson, Mr. Theo. Payne, Dr. J. Comstock.

Advisory Board: Mr. R. F. Gross.

Visitors: Dr. Bryan.

Approved August 29, 1921.

JOHN COMSTOCK, Secretary.

DIRECTORS' MEETING

August 29, 1921.

A special call meeting of the Directors, Southern California Academy of Sciences, was held in the office of the Treasurer, 1110 Van Nuys Building, on August 29, 1921.

Called to order by the President, Dr. Frank Clark, at 11:20 A. M.

A report of the Membership Committee was verbally presented. Mr. Keese also submitted a summary of all memberships to date, as follows:

Active members	289
Non-resident members	59
Total	348
Foreign—Exchange and complimentary members	31
Life members	22

HONORARY MEMBERS

Geo. E. Hale
Prof. G. W. Ritchey
B. R. Baumgardt
G. Allen Hancock
S. B. Parish

Mr. Keese moved, Mr. Parsons seconded that the Academy of Sciences assume and agree to pay for the printing of colored plates illustrating Dr. Comstock's articles on the Butterflies of California now being used in the Academy "Bulletin," said expense not to exceed the sum of sixty dollars per plate. Motion unanimously carried.

On motion of Mr. Parsons, seconded by Mr. Keese, the Secretary was instructed to communicate with Mr. Enos A. Mills, of Longs Peak, Colorado, with a view to the possible booking of a lecture, or series of lectures for the Academy. Motion carried.

Present: Mr. Geo. Parsons, Mr. S. J. Keese, Dr. Ford Carpenter, Mr. J. O. Beebe, Mr. Theo. Payne, Dr. F. Clark, Dr. J. Comstock.

JOHN COMSTOCK, Secretary.

DIRECTORS' MEETING

December 3, 1921.

Held in the office of Treasurer S. J. Keese, 1110 Van Nuys Building.

Present: Dr. F. Clark, presiding; Dr. Davidson, Mr. Keese, Parsons, Spalding, Payne, Beebe, Dr. M. Baumgardt and Dr. J. A. Comstock.

Guests: Mr. Alder.

After some discussion, re the desirability of holding certain of the Academy meetings in the City Club, Dr. Davidson moved, Mr. Parsons seconded that the President appoint a committee with executive power, to decide in the matter. Motion carried. Mr. Keese was appointed chairman, to name his own committeemen. Mr. Keese named Dr. Davidson and Mr. Spalding to serve with him.

Mr. Keese reported that he had sold part of the Liberty Bonds for the Academy at 96.32 and reinvested the funds in the bonds of the Trinity Building Company. It was moved by Mr. Parsons and seconded by Mr. Spalding that this action be sustained. Motion carried.

Mr. Alder reported on the present status of the Academy's Yukon film, pledging his assistance in disposing of the picture. Mr. Keese was authorized to negotiate further with Mr. Alder, with that end in view.

Mr. Payne moved, Mr. Keese seconded that all active memberships, including non-resident, be $3.00 per annum. Motion carried.

The following were elected to active membership in the academy: Mrs. Theodore Payne, Mr. Thos. E. Stimson, Dr. F. G. Smiley, Mr. F. G. Johnson.

JOHN COMSTOCK, Secretary.

DIRECTORS' MEETING

December 28, 1921.

Held in Treasurer's office, 1110 Van Nuys Building. Meeting called to order at 12:15 P. M. by President Clark.

Those present were: S. J. Keese, Treasurer; Dr. F. J. Clark, President; Messrs. Payne, Spalding, Parsons, Drs. Carpenter, Baumgardt, Comstock.

Mr. Keese called attention to the need of assistance in his department, particularly at the time of publication of the "Bulletin." Several volunteered a portion of their time.

It was suggested that a printed circular be mailed to all members, outlining the policies of the Academy for the coming year, and urging each member to bring in one new member for the Academy in 1922. This suggestion met with unanimous approval and the matter was placed in Mr. Keese hands.

Mr. Spalding moved, Parsons seconding, that Mr. J. O. Beebe's resignation as Director and member of the Academy be accepted. Passed.

Mr. Keese moved, Mr. Spalding seconded, that Dr. William Alanson Bryan be elected to fill the vacancy. Unanimously passed.

It was moved by the Secretary and seconded by Mr. Spalding that printer's bill for Bulletin No. 3 of Vol. 20 be paid. Passed.

Dr. Clark reported that the Santa Monica Branch of the Academy had a membership in excess of sixty.

Adjourned at 1 P. M.

John Comstock, Secretary.

Committees for 1921

Committees Appointed by the President, in Conformity with the Constitution.

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Dr. A. Davidson
S. J. Keese

Program Committee

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Dr. A. Davidson
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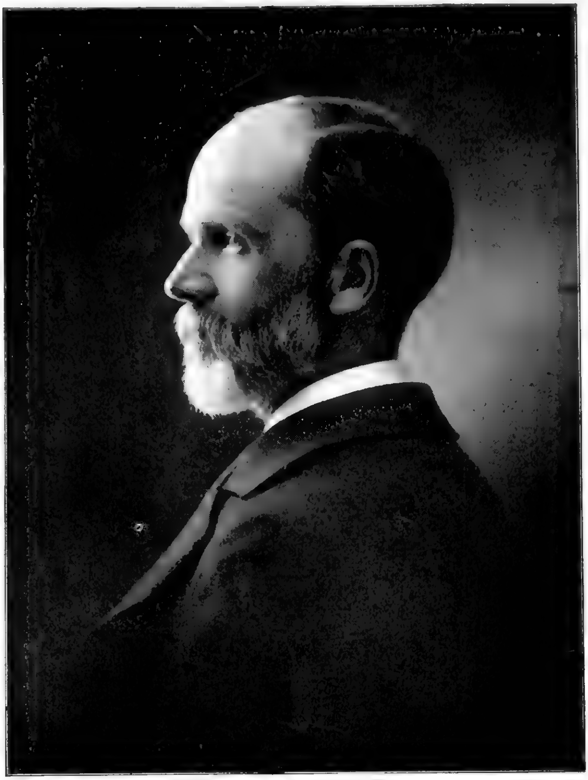

IN MEMORIAM

Willard Atherton Nichols

Willard Atherton Nichols, a member of this Academy of Sciences, died on August 22, 1921, at Redlands, California.

Descended from ancestors who were of the very first,—from the Mayflower down to the end of the Puritan immigration,—to establish a new home and an unique government for themselves upon the far East Atlantic coast, many of whose names are emblazoned upon the imperishable pages of our Colonial History, his entire life from boyhood to the end, has run through all the phases of romance, material activities and historic and scientific investigation.

Graduating from Harvard University in 1865, he very rapidly demonstrated his ability as a Civil Engineer, in which vocation he was engaged during the succeeding twenty-five years.

Under his plans and direct supervision as Chief Engineer, were constructed the New Brunswick Railway of Canada and the European and North American Railroad in Maine, which was dedicated for operation by President Grant.

During the last eleven years of his professional life he was Principal Assistant Engineer of Docks in New York City.

By reason of failing health he abandoned his career of Civil Engineer and coming to Los Angeles in 1898, he made his permanent home in Redlands.

Although of the most reserved and modest character his eminent abilities rapidly became known throughout his new environment. He was chosen a member of the first Highway Commission of San Bernardino County and during many years he was frequently consulted in the construction of mountain trails and roads, irrigation systems, bridges and other works of a public character, by the authorities of San Bernardino County.

He was retained by successive elections up to his death as Trustee of the Smiley Public Library. He was the mainstay of the Fortnightly Club and to him the Unitarian Congregation of Redlands owes a most exquisite church structure.

In other phases of his life he was a member of the American Society of Civil Engineers, the Mayflower Society, the Societies of Colonial Governors, Colonial Wars, Sons of the Revolution, War of 1812, the Harvard Club of Southern California and many other clubs and associations of a literary and social character.

He was intensely interested in the Public Schools and a proper course of instruction for the young and he was a factor in the establishing of a College in Redlands.

In the early days of the Southern California Academy of Sciences, he became a member, and in him we had an associate whose zeal and interest in our work never lessened.

He was an intense student in Archaeology, Geology, Astronomy and Ethnology, and his library contained many rare—ancient and modern—volumes devoted to these branches of Science, and probably his book shelves embraced a more ample and thorough collection of reliable authority relating to the genealogy and biography of New England than is to be found in any private library in California.

This Academy of Sciences places this Memorial upon its Records as a Testimonial of a member who honored us by his association, a scientist of profound erudition, a gentleman whose amiable character had drawn to him the affection of all who knew him and whose reputation for ability and achievement became National.

Holdridge O. Collins.

Publications of the
Southern California Academy of Sciences

The Academy has published to date the following:

PROCEEDINGS. 1896 to 1899. Six numbers—Vol. 1, Nos. 1 to 6.

MISCELLANEOUS BULLETINS issued under the imprint of the Agricultural Experiment Station—1897 to 1907. *Ten numbers.*

All issues of the above are now out of print.

Bulletin of the
Southern California Academy of Sciences

Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

The 1921 issues to date are: Vol. XX, No. 1, April; Vol. XX, No. 2, August; Vol. XX, No. 3, December.

All of the above are now out of print, with the exception of the following, which may be secured from the Secretary of the Academy at the appended prices:

Vol.	1,	No.	1.	January,	1902	$1.00
"	1,	"	2.	February,	1902	1.00
"	3,	"	7.	July	1902	.25
"	4,	"	3.	March,	1905	.75
"	4,	"	5.	May,	1905	.25
"	6,	"	2.	July	1907	.25
"	7,	"	1.	January,	1908	.75
"	9,	"	1.	January	1910	.75
"	9,	"	2.	July,	1910	.75
"	10,	"	2.	July,	1911	.75
"	12,	"	1.	January,	1913	.50
"	13,	"	1.	January,	1914	.75
"	13,	"	2.	July,	1914	.75
"	14,	"	1.	January,	1915	.75
"	15,	"	2.	July,	1916	.50
"	16,	"	1.	January,	1917	.75
"	16,	"	2.	July	1917	1.00
"	17,	"	2.	July,	1918	.75
"	18,	"	1.	January,	1919	1.00
"	18,	"	2.	July,	1919	.75
"	19,	"	1.	January,	1920	.25
"	19,	"	4.	October,	1920	.25
"	20,	"	1.	April,	1921	.25
"	20,	"	2.	August,	1921	.25
"	20,	"	3.	December,	1921	.25
"	21,	"	1.	March,	1922	.25

The Academy is desirous of completing its files in certain issues and will appreciate the donation of all numbers by members who have no further use for back issues. Address all communications concerning the above to:

Dr. John A. Comstock, *Secretary.*

Southern California Academy of Sciences, Southwest Museum
Los Angeles, California

BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Vol. XXI, Part 2
October 1922

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530 Auditorium Bldg.   Los Angeles, Cal.

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GEOPHYSICAL RECORDS, 1922.

By Ford A. Carpenter, Sc.D., LL. D.

An interesting feature in the study of statistical meteorology and physiography is the collection of record-breaking figures. As a matter of general information, a few lines of authentic data concerning the earth and its atmosphere have been prepared.

The compilation which follows is mainly devoted to the meteorological features such as temperature, rainfall, wind, sunlight, fog, etc., but other related phenomena—the penetration of the upper air strata by balloon soundings and in other artificial flight—as well as recent determinations of physical depressions and elevations, observations of sea-waves, etc. are also included. To students of geography especially will this group be found of more than ordinary interest. To Californians it will be particularly noteworthy to observe the place this state holds in having recorded the highest temperature ever registered on the earth's surface (134° in Death Valley) also as making the highest sounding-balloon altitude (20.4 miles at Catalina Island) above the earth's surface. California has the record of the greatest depth of snow ever having fallen in the United States (amounting to 73.5 feet in one year) and the greatest depth (37 feet) of measured snow on the ground at one time. Also the greatest elevation in the United States (not including Alaska): that of Mt. Whitney with 14,501 feet above sea level, as well as the greatest depression (over 300 feet below sea level).

TEMPERATURES (Degrees Fahrenheit)

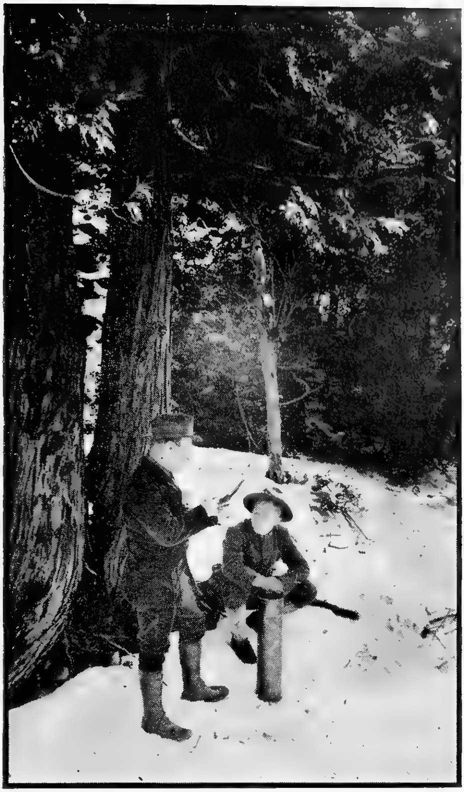
(NOTE: References, such as "E," etc. are explained at end of article.)

Highest natural air temperature ever recorded on the earth's surface was 134° on July 10, 1913, at Greenland Ranch, Death Valley, California (E).

Lowest air temperature ever recorded was 90.4° below zero on Jan. 15, 1885, at Verchoyansk, Siberia (A). The lowest temperature ever recorded in the United States was 68° below zero on Jan. 12, 1916, at Saco, Montana (E). The mean temperature at Verchoyansk, Siberia for the month of January, 1885 was 64° below zero, and during December of the same year the maximum temperature for the month was 33° below zero (I). A temperature of 456° below zero has been obtained by cooling liquid helium; this is a temperature approximately within 3° of "absolute zero." (H)

Diurnal variations in temperature—The temperature has risen over 50° in 24 hours at many places in the United States; at Florence,

PLATE I.



MEASURING SNOW IN SAN ANTONIO CANYON

Photo by Carpenter

Arizona, the temperature rose 65° in 24 hours on June 22, 1881 (I). The temperature has fallen more than 50° in 24 hours on several occasions: At Abilene, Texas, the temperature dropped 63° in 16 hours on Jan. 27, 1886 (I).

Monthly and Annual ranges in temperature—Yakutsk, Siberia, has the greatest difference (181.4 degrees) between the highest summer temperature and the lowest winter temperature (I). Miles City, Montana has the greatest range in temperature in the United States; maximum 112°, minimum 65° below zero, range, 177° (E). The temperature range for the month of December, 1880, was 117° at Fort Benton, Montana (I).

RAIN AND SNOW

Greatest annual rainfall—Cherrapunji, India, recorded 905.1 inches during the year in 1861 (I). The average annual rainfall at that station is nearly 500 inches (L).

Greatest daily rainfall—Baguio, Philippine Islands recorded 45.99 inches between noon of July 14, 1911 and noon of the next day (J). Curtea de Arges, Roumania registered 8.07 inches in 20 minutes on July 7, 1889 (D). The greatest rainfall of short duration fell at Porto Bello, Panama, when 2.48 inches fell in 5 minutes, beginning at 2:07 A. M. Nov. 29, 1911 (D).

Hailstones—Hailstones 12 inches in circumference fell in Maryland on June 15, 1915 (D).

Snowfall—The greatest snowfall in the United States probably falls in the mountains of California. Tamarack, Cal., recorded 786 inches of snow in the winter of 1911; during one winter this station registered 882 inches of snow, and amounts of 450 inches have been measured on the level ground at one time (D, E.).

Wind—The average hourly wind velocity at Mt. Washington, New Hampshire, on Feb. 27, 1886 was 111 miles per hour, and a maximum velocity of 186 miles per hour was registered in January, 1878 (I). The average hourly wind at Mt. Washington for the month of January, 1885 was 49 miles per hour (I).

Sunlight—Sixty hours of continuous sunshine were recorded automatically in the Antartica during the period December 9 to 12, 1911 (M.)

Fog—A dense fog in London lasted from Nov. 1, 1879 until February, 1880 with practically no cessation night or day (M).

Altitudes by artificial flight—Highest airplane flight was made on Sept. 28, 1921, at Dayton, Ohio, by Lieutenant McReady, A. S., attaining an elevation of 40,800 feet above sea level. Highest manned balloon flight was made in 1909, in Italy, reaching an altitude of 38,700 feet (C). Highest sounding balloon ascent made at Avalon, Catalina Island, California, on July 30, 1913, reaching an elevation of 108,000 feet, or 20.4 miles above sea level (D).

On October 5th and 6th, 1922, Lieutenant John A. MacReady and Lieutenant Oakly Kelly, of the United States Air Service, remained aloft thirty-five hours in a monoplane engined by Liberty motors. This is a world record.

Elevations and depressions on the earth—The highest point of land in the world is Mount Everest, elevation 29,002 feet (L); the summit has not been reached by man, but ascents were made in 1922 within 1,700 feet of the top. The highest point of land in continental United States is Mount Whitney, California, elevation, 14,501 feet (L). The lowest point of land in the United States is Death Valley which is over 300 feet below sea level. The deepest point reached in deep sea soundings is 32,078 feet in the Pacific Ocean near the Island of Mindanao, Philippine Islands (G).

Highest Sea-waves—Waves of 50 feet in height (trough to crest) and 220 feet in length (crest to crest) were encountered in the North Atlantic Ocean on March 4, 1922 with a wind blowing 100 miles per hour (F). The record difference between high and low tide occurred in the Bay of Fundy in 1869 when the tide reached 53 feet above low water (N).

REFERENCES

Authorities from which the preceding data were abstracted are shown in the following table. The letters in brackets after each item refer to the source of information, as, for example, (A) Milham, Meteorology, etc.

A Milham, Meteorology.

B Humphreys, Physics of the Air.

C Taylor, Australian Meteorology.

D Monthly Weather Review.

E Climatological Data Sheet, U. S. Weather Bureau.

F Hydrographic Bulletin, U. S. Navy.

G Websters Dictionary, 1922.

H Black and Davis, Practical Physics.

I Greely, American Weather.

J McAdie, Principles of Aerography.

K Scott, Voyage of Discovery.

L Mill, The Realm of Nature.

M Journal of the Royal Meteorological Society.

N Wheeler, Waves and Tides.

NEW BOTANICAL SPECIES FROM S. CALIFORNIA

A. DAVIDSON, M.D.

Langloisia Flaviflora n. sp. Low matted, shortly branching, dark green, spinescent annual about 5 cm. high; foliage glandular pubescent; leaves sessile, strap shaped, 15-25 mm. long, 3 mm. wide, slightly narrower at the apex, leaves edged with 10 or more triangular based white spines mostly crowded towards the base; apex of the leaf triangular and spine tipped with 2 similar spines at the side; flowers light yellow, sessile, 10 mm. long; calyx split almost to the base slightly accrescent, its segments 5 mm. long, spine tipped; corolla tube white, cylindrical, 5 mm. long, 1 mm. wide; throat yellow; limb strongly bilabiate, pale yellow, its segments 5 mm. long, 1 mm. wide; stamens exserted 2 mm. beyond the throat; pistil equalling the calyx; seed pod pyriform, 6-seeded.

Type No. 3506. On sandy roadside, Willow Springs, Mohave Desert, Kern Co., May 28, 1922.

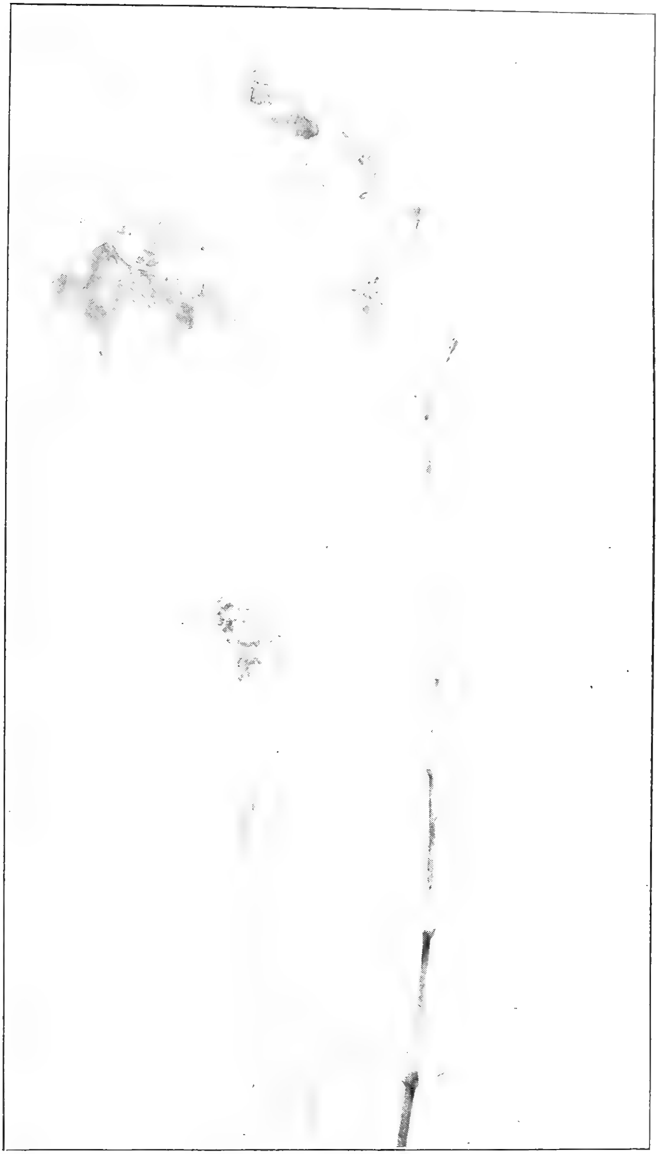
In habit of growth this plant closely resembles **L. Matthewsii** but is smaller, less pubescent, with leaves somewhat similar, but with a totally different flower, that of **L. Matthewsii** being a mottled pink—the limb measuring 10 mm. in length. The style in the latter is much exserted.

Allium Tenellum n. sp. Bulb without definite reticulation; stem 10-15 cm. high; leaves 2, shorter than the stem; pedicels 15-25, 10 mm. long; flower pinkish, open, the segments not overlapping; perianth segments thin, lanceolate, acute, 6 mm. by 3 mm., the outer with a greenish median stripe, the inner slightly narrower without the stripe; stamens nearly equaling the perianth, anthers pink; filaments linear; pistil 5 mm. long; stigma slightly 3-cleft; ovary with 6 flat triangular crests in pairs with the straight sides of the triangles edge to edge. In fruit the outer pedicels are declined and curved. Type No. 3524 Julian, San Diego Co., collected by Mrs. J. H. Bullard, May, 1922.

This adds another to the group of Alliums having 3-split stigmas. Brewer and Watson in Bot. Cal. recorded only **A. Parryi** and **A. fimbriatum** as having this distinction. Jepson in his Flora of Cal. has entirely omitted all reference to the nature of the stigma in all our southern species. The shape of the stigma is probably a stable factor of diagnostic import. In southern Cal. we have **A. Parryi; A. fimbriatum; A. Kressleri; A. tenellum; A. montigenum;** and **A. peninsulare,** with 3-cleft stigmas.

The latter two are somewhat alike. **A. montigenum** is lighter in color with narrower petals that do not form an inner cup as accurately described by Jepson. The chief difference is in the fruit. In **A. peninsulare** as we have it here, the ovary is crowned by a low continuous

PLATE II.



crest about 1 mm. high that surrounds the pistil like a collar. In **A. montigenum** this is entirely absent. **A. peninsulare** has only been found in Glendale hills and in Santa Susanna Pass (Kessler). Specimens from Kern Co., (Mrs. W. Hutchinson) are typical. What seems typical **A. amplectens** was gathered in the Corona and Temescal Mts. **A. Piersonii** Jepson is a synonym of **A. monticola** Davidson.

Fritillaria Ojaiensis n. sp. Bulb ovate with rice-grain bulblets at base; stems about 6 dm. high; lower leaves linear in whorls of 3-15 cm. long, 5-7 mm. wide, at basal attachment 3 mm. wide, upper leaves few, alternate flowers 6 or 7 campanulate subtended by narrow leaves, 5-10 cm. long; pedicels 2-3 cm. long; petals lanceolate, 2 cm. long, 8 mm. wide, greenish yellow above with scattered dark dots, darker below, the gland semi-circular, very small; stamens 2/3 the length of the petals; 3-5 mm. long; pistil cleft to below the middle; capsule unknown.

Type No. 3508 collected on a dry ridge at Pine Flats, Santa Paula River by Lustin E. Martindale, May, 1922.

While this plant seems closely similar to some of the forms of **F. lanceolata,** the size and shape of the leaves, color of the flowers and the size of the anthers are sufficiently charactristic to entitle it to specific rank. No specimens of **F. lanceolata** have been found south of San Francisco.

NOTES ON SOME SAN BERNARDINO PLANTS

J. B. Feudge

Fraseri Parryi Torr. For the last three years I have found this plant northwest of San Bernardino in the open ground among the chaparral, about one mile away from the lower edge of the San Bernardino Mts. I have noticed about a dozen plants altogether in this time. I found one more there last week and I have no doubt that a careful search would reveal quite a few at this station. I am mentioning this occurence as it has always been a question as to where Dr. Parry found the plants mentioned in the Bot. Cal. as occuring "east of Los Angeles." It must be admitted that this station is quite a distance from Los Angeles, still it might be the place where he found his plants. In the Torrey Bulletin for Feb. Messers Johnson and Munz mentioned the finding of one plant in the hills north of San Dimas and speak of the species occurring in the Transition Zone of the San Bernardino and San Jacinto Mts. Evidently

they did not know of its occurring regularly on the open plains northwest of San Bernardino.

Purshia glandulosa Curran, and **Prunus fasciculata** Gray, I can find no account in Parish's "Plants of the San Bernardino Mts." or in Abrams' "Trees and Shrubs of Southern California" of either of these shrubs having been found on the south side of the San Bernardino Mts., (the Cismontane Area). If I have identified this plant correctly **Purshia glandulosa** is fairly plentiful at Verdemont, a station on the Santa Fe, about 8 miles east of San Bernardino and some miles below the lower edge of the mountains. **Prunus fasciculata** grows near Cajon Station on the Cismontane slope of the mountains about 4 miles below the summit of the Cajon Pass. Abrams does speak of this shrub being found in Lone Pine Canyon which is some miles to the west and I think on the desert slope.

Yucca Mohavensis Sargent. There are 3 or 4 large plants of this species to be found in the Plung Creek wash, two miles south of Highlands, and six miles north of the mouth of San Timoteo Canyon. The trunks measure about 15 feet long as they lie prostrate near the ground. Prof. Jepson in his "Flora of Cal." speaks of this plant as "extending west to the San Bernardino Valley," but he gives no specimens from the valley. He records one from the San Timoteo Canyon, a canyon leading into the valley where there are or were some plants of the species near the lower or cismontane exit. But the plants I have reference to are about 6 miles inside of the San Bernardino Valley.

STUDIES IN PACIFIC COAST LEPIDOPTERA,

Continued.

DR. JOHN A. COMSTOCK

Notes on the acmon-neurona group of Lycaenids, with description of a new species.

The relationship of the six species and one variety of Lycaenids comprising this group has been obscure, and several papers written to clarify the matter have unfortunately further complicated the problem. This lack of clarity results in part from the extremely brief descriptions of the earliest published species, and to some extent, from the small series which were available to the several authors who have written on the problem. An exact knowledge of the interrelations of the group will not be possible until a long series of each species has been bred under varying conditions of climate, altitude and season, but certain conclusions may be reached by a comparison of series covering a wide geographic range.

Plebeius acmon is too well known to deserve comment. Mr. Victor L. Clemence has given valuable notes on the species and its seasonal forms in the Canadian Entomologist, Vol. XLI, p. 38, 1909. He has pointed out the fact that the early spring form is "small in size, of a darker blue than the type form, and heavily margined in black." His remarks refer, of course to the male only. The female of this form tends to have the basal portion of primaries and secondaries heavily shot with blue, whereas the later generations are uniform slatey-brown. In the male of these later forms, the ground color is a delicate violet, and the orange band on upper side of secondaries is overshot with rose.

Boisduval's **antaegon** refers to the summer form and is undoubtedly synonymous with acmon.

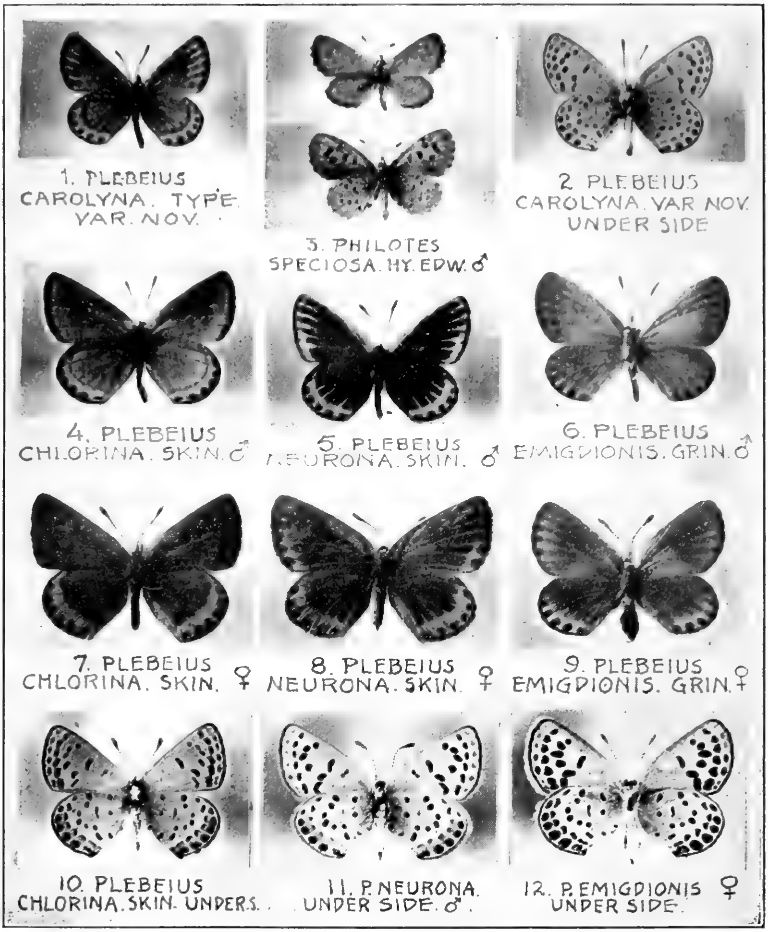
Grinnell's **cottlei** is a race of acmon occuring in the San Francisco Bay region (the types taken at Bakers Beach). It is an early spring form, and can be distinguished from the typical by the "intensity, sharpness and distinctiveness of the deep purplish blue, the heavy black border; the greatly extended deep red border of the hindwings; and darker ashy-gray and distinct markings of the undersides."

Boisduval's **lupini** is undoubtedly an alpine race of acmon occuring at points in the high Sierras. In size it averages as large **as monticola.** It is difficult to separate from large specimens of the summer form of acmon, but a few points of differentiation seem fairly constant. In the male it is noted that the marginal dark band on upper side of primaries gives place gradually to the violet-blue ground color. This marginal band is also wider than in other forms of acmon. The orange band on upper side of secondaries is bordered internally with a dark shading and the color is distinctively orange whereas in typical acmon it shows a rosy lustre and is not usually internally shaded.

Plebeius monticola, Clemence is a well defined mountain race of acmon occuring in the Southern Sierras, the type locality being the San Gabriel mountains. It may be distinguished from other varieties by the silvery-blue ground color, the broad marginal band on upper side of primaries, and in the female, which is almost as blue as the male, by the broad orange band of upper side of secondaries. Both sexes show relatively heavier markings on the under side than do other forms of acmon.

Plebeius chlorina, Skinner is a form that has been much misunderstood. Dr. Skinner's first description, occuring in the Entomol. News, Vol. 13, p. 15, 1902, erroneously spoke of the **female** having an "overlying iridescent, very light green." This was later corrected in W. G. Wright's "Butterflies of the West Coast," where Dr. Skinner is quoted as saying "my three specimens are males." Undoubtedly the original description was of a male rather than a female as originally stated. I have a long series of this form from the type locality in the Tehachapi Mountains. The males could be considered as monticolas in which the silvery-blue had changed to a lustrous blue-green. On the underside of the wings they can not be distinguished from typical acmon. In size they are intermediate between typical acmon and monticola. The female which seems to be associated with this greenish male (though none were taken in copulation) is almost identical with large sized specimens of the summer form of acmon. The ground color of the former is perhaps more brown and the orange band on upper side of secondaries uniformly wider. Only one specimen shows a slight powdering of greenish scales on the primaries, (in the basal area). All the others are a uniform brown. There is wide variation, tending on the one hand to small specimens that are indistinguishable from acmon, and on the other to large, orange-suffused examples that approach typical females of neurona.

PLATE III.



1. PLEBEIUS CAROLYNA. TYPE. VAR. NOV.
2. PLEBEIUS CAROLYNA. VAR. NOV. UNDER SIDE
3. PHILOTES SPECIOSA. HY. EDW. ♂
4. PLEBEIUS CHLORINA. SKIN. ♂
5. PLEBEIUS NEURONA. SKIN. ♂
6. PLEBEIUS EMIGDIONIS. GRIN. ♂
7. PLEBEIUS CHLORINA. SKIN. ♀
8. PLEBEIUS NEURONA. SKIN. ♀
9. PLEBEIUS EMIGDIONIS. GRIN. ♀
10. PLEBEIUS CHLORINA. SKIN. UNDERS.
11. P. NEURONA. UNDER SIDE. ♂.
12. P. EMIGDIONIS ♀ UNDER SIDE.

One remarkable variation in the male, evidenced by five specimens in my series is sufficiently distinct to deserve a varietal name. I will therefore designate this.

Plebeius carolyna, form nov: naming it for my loyal co-worker and wife, Dr. Carolyn Comstock, who captured three of the five specimens in my series.

Expanse—19-25 mm.

Upper surface as in typical chlorina, i. e. ground color, lustrous blue-green; outer margin brown; fringes white. **The nervules on outer third or fourth of primaries, orange** (as in neurona) beginning at a point about one mm. internal to outer margin, these orange lines expand as they approach the junction between the blueish-green ground color and the marginal band; they again gradually diminish as they approach the limbal area, until they finally disappear. Secondaries, ground color bluish-green. Outer marginal orange band wide, and bordered internally with 5 points of shading in juxtaposition to the five submarginal round spots. A dark fine marginal line. **Under surface,** as in typical chlorina. Thorax, dorsal surface blackish covered with filamentous greenish scales; beneath, greyish-faun. Abdomen, dorsal surface dark shading to grey laterally, ventral surface, silvery grey.

Antennae, clubs black, segments annulated black and white.

Type locality: Tehachapi Mts. about five miles from the town of that name. Elevation 5,000 feet. The type taken on July 1st. Paratypes 1, 2, 3 and 4, taken respectively on July 7, July 11, and July 22.

Type and paratypes in the Southwest Museum Collection.

This form is in practically all respects similar to chlorina, but may at once be distinguished by the orange lineation on the nervules in outer portion of primaries. Possibly it may have arisen as a result of interbreeding with neurona, which is found in the same locality.

Plebeius emigdionis, Grinnell. Ent. news, Vol. 16, p. 115, 1905.

This species was first described by Fordyce Grinnell, Jr. from specimens taken in San Emigdio Canyon, Kern Co. Doubt was later thrown on the validity of the species by Mr. Karl Coolidge's notes in the Entom. News of 1907, Vol. 18, p. 300, who states "a later examination of Mr. Grinnell's specimen proves them to be all females, and - - - - - emigdionis is probably only a variety of acmon."

I have taken this species in Mint Canyon, and also have a good series from Victorville, Mojave Desert, (taken in May of this year) where it flies in abundance. It is undoubtedly a valid species, totally distinct from acmon, which also occurs in the same district. Its flight is more energetic and its habits very different. The male and female may be easily distinguished, as a glance at the accompanying plate will determine. I have taken several pairs in copulation.

It differs markedly from all forms of acmon in several particulars, chief of which are:

In the male, the blue scales on upper surface are concentrated most heavily in the basal area and gradually give place to the dark marginal shading. The marginal orange band on secondaries of acmon is represented only by a brownish or yellow-brown suffusion on which are slight shadowy suggestions of dark spots. The type, specimen has three such spots suggested, but the majority of the males show only one or two. On the under surface we find the ground color practically alike in the two sexes, whereas in acmon the ground color of the males is lighter. Another striking point of difference is the series of black spots distal to the reniform discal dash. In both sexes of emigdionis these are fully twice the size of the marginal series and are irregularly cuneiform, whereas in acmon they are relatively much smaller, oval in form and more evenly aligned. A clear distinction rests in the five submarginal metallic rings on under side of secondaries which are relatively much larger in emigdionis than in any form of acmon. The "orange" crescents internal to these are reduced to about ½ mm. and are not orange but yellow. The upper surface of female may be separated from acmon by the broad outer yellow-brown suffusion which gradually diminishes in the limbal area. This suffusion is somewhat more concentrated along the lines of the nervules and gives a slightly "neurated" effect to the wing, which has not been noted in the authors original description, but is clearly present in the types. The figures which I show have been compared with the latter.

Plebeius neurona, Skinner. Entom. News, Jan. 1902, Vol. XIII, p. 15.

This rare and remarkable Lycaenid was first taken by W. G. Wright at Doble, an old Mining Camp in the San Bernardino Mountains. Of late years our local collectors have depended on the summit of Mt. Wilson to supply their specimens but the latter col-

ony seems now to be exhausted. The Mt. Wilson captures were all smaller than the typical, ranging from 17 to 20 mm. My wife and I have recently found a colony of neurona in the Tehachapi Mountains, at an elevation of over 6,000 feet from which a generous series was secured. These latter captures are all larger than the Mt. Wilson specimens, ranging from 20 mm. to 28 mm. in expanse. They are otherwise typical, and show the usual wide range of variation characteristic of the species. Dr. Skinner has stated that there are no secondary sexual characters in neurona but we note one difference that seems fairly constant throughout our series of 70 specimens. In the males, an orange suffusion extends along the costal margin of primaries (upper surface) which is widest at the base and tapers toward apex. Only two females in our series show any suggestion of this.

The variation in neurona consists principally in the degree and extent of the orange "veining." This ranges from clearly marked individuals in which every nervule is distinctly lined with orange, to specimens in which there is no orange whatsoever on the nerves and which are practically indistinguishable from acmon females.

The accompanying plate illustrates several of the points of differentiation which we have here analyzed. In addition to showing Plebeius emigdionis, neurona, chlorina and the new variety carolyna, there is shown a cut of the male of Philotes speciosa. This rare Lycaenid has been taken in isolated points of the Mojave Desert.

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